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Your own Telephone Companies. Then you will always **have control** of the best and quickest means for reaching your neighbors and the outside world. A telephone will pay for itself in a season. By organizing a company you can also **effect a great saving in the cost** of telephones and equipment.

Don't Depend upon the tender mercies of the "trusts." They **never sell** telephones, but **put you under tribute.** If you own your own system, you save the trust's profits for yourself.

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THE KELLOGG GUARANTEE

which is worth the cost of your telephones, is back of every telephone and switchboard that leaves our factory. **We are independent manufacturers. Organizers wanted** in territory not already taken. Write us at once.

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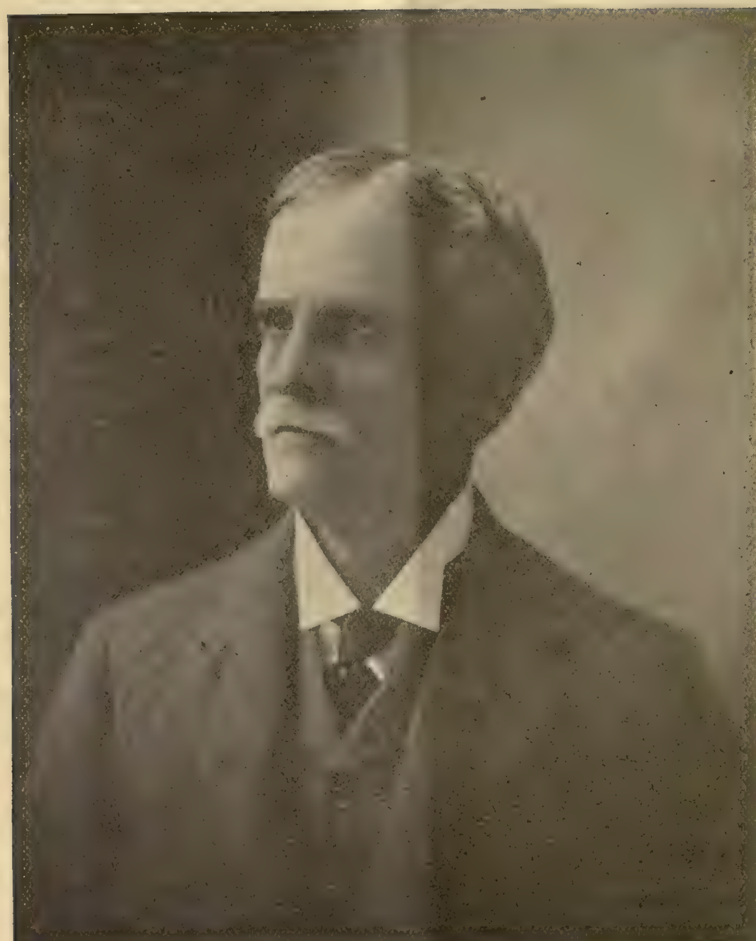
Now is the time to purchase a farm or stock Ranch in the best farming and stock-growing portion of Eastern Colorado. Choice farms and unimproved lands for sale or trade. Stock ranches with good summer and winter ranges. If you want to buy or have unincumbered property to trade let us hear from you. Write us before you invest elsewhere.

A. L. KISSINGER, Yuma, Colorado.



JOHN E. FROST.

President of the Commercial Club of Topeka, Kansas, and formerly Land Commissioner of the A. T. & S. F. Ry.

THE IRRIGATION AGE.

VOL. XVII. CHICAGO, JANUARY, 1902. NO. 1

Special Notice. **The new management of the IRRIGATION AGE hopes to avoid even the slightest confusion or error in the transfer of mailing lists, correspondence, etc., and while begging the indulgence of its readers for any possible oversight makes the precautionary request for an immediate report of any failure to receive the IRRIGATION AGE in regular course.**

To accommodate a larger circulation the lists are being carefully rearranged in a more convenient and reliable system of record which will overcome any annoyances or delays to which subscribers may have been subject.

Greeting. Under its new proprietorship and editorial management the IRRIGATION AGE begins the new year with firm confidence in the greater progress and development of American irrigation interests demanded by the rapid growth of our country and the extension of our trade around the world.

The IRRIGATION AGE will continue to be issued from Chicago, and with those desirable changes suggested by seventeen years' experience will aim to not only please and satisfy its old friends and regular readers, but rapidly interest and become indespensable to an increasing clientele through the value of its educational, as well as its popular and scientific features.

The regular and special contributions from eminent authorities on various phases of irrigation will maintain the highest standard of excellence and the contents of each department, with timely and suitable illustrations, will prove interesting to the farmer, manufacturer, land owner, stockman, miner, merchant and investor.

The editorial telescope will constantly sweep the horizon for the newest and most important information on every topic relating to irrigation and its dependent industries.

THE IRRIGATION AGE will support every reasonable public measure and will strive unceasingly to promote popular education in Irrigation and Forestry and the growth and organization of sentiment friendly to the reclamation of every unproductive acre within the reach of water, now lying waste within our borders.

While hoping to merit commendation we shall consider earnest criticism and practical suggestion the highest test of friendship.

We are grateful to the staunch supporters of the IRRIGATION AGE who have bravely carried it through the storm and stress of pioneer life and pledge renewed devotion to even more ardrous service and appreciation when Irrigation is to become a greater problem for popular discussion and settlement.

From the Railroad Standpoint. That the importance of western development is well estimated by the railway managers of not only the western but eastern trunk lines, and that these same discerning minds appreciate the necessity for some public measure supporting a more comprehensive plan of Irrigation is clearly indicated by W. C. Brown, of Cleveland, O., Vice-President and General Manager of the Lake Shore & Michigan Southern Rairway, in

a recent interview in which he says:

"I cannot express too strongly my appreciation of the recommendation of the President looking to the reclamation of the now arid regions in our western states and territories by the construction of great reservoirs for the storage of water. The fact that the President favors the undertaking of this work by the general government is the logical result of his familiarity with conditions in the West, and his practical knowledge of the subject under consideration.

"The work of reclamation of arid lands undertaken in the comprehensive and thorough manner which its importance not only justifies but demands, will require a larger expenditure of money than the sparsely settled states of the West can command. Money for this purpose expended by the state must be raised by taxation; this is an obvious impossibility; therefore, the only alternative left to the state or territory unaided by the general government would be to farm out to great syndicates composed of eastern capitalists the right to construct the reservoirs, to own the water and to control the lands reclaimed. Under this plan the settler seeking a home upon government land must pay tribute to the syndicate thus formed in such amount as the syndicate might elect to exact.

"The hope of this country, the sheet-anchor of its safety, in the days to come lies in the rural districts; the one overshadowing cloud more portentous than any other to-day is the rapidly growing political representation and influence of the great centers of population as against the country. The hope of the country is in the forty, eighty and 160 acre farms—thousands of them—owned and tilled by happy, prosperous American citizens, and in no way can this condition be brought about so speedily as by the government undertaking at once the work of reclaiming and making fruitful and fertile the millions of acres of land now its property, but absolutely worthless without water.

"No recommendation or suggestion has ever been made by a President more important than this or worthy of more careful consideration, and I hope to see an appropriation for the reclamation of the arid lands of the nation made as regularly as that for rivers and harbors, or for any other great and necessary work of the national government, and that the appropriation will be commensurate in amount with the great importance of the work."

The President's Message. If our national strength and prosperity are chiefly founded on agriculture and kindred pursuits, no single feature of the president's message so vitally concerns the future welfare of our country or so persistently appeals to the crowded population of the great commercial centers as his earnest practical plea for preservation of the forests and the establishment of a scientific, adequate system of irrigation, national in extent and benefit, and fully fitted to the ultimate requirements of our vast desert domain.

This encouraging recognition of a great public necessity draws strong significance from his active, early experience in western ranch life, for, of all our presidents, Theodore Roosevelt most happily posseses the intimate knowledge of western affairs and that generous infusion of western spirit which should characterize the broad-minded representative statesman.

The narrow sectional view is impossible to an intelligence quickened by impartial sympathy with every phase of national opportunity or progress.

The eastern states can never be wholly independent of the west while they consume bread and meat, and while as a growing nation we hope and strive for the grandeur of our appointed destiny.

The voice of promise in the president's message must be hailed with delight by every citizen of our broad land havin

faith in the abundant resources of western soil and climate. The spirit of expansion needs no more fertile field of action than arid America influenced by properly diverted waters of now useless and uncertain streams.

The parched hand of drouth waves no welcome to eager emmigration, but with certain and constant water supply the barren plateaus of the west, transformed and regenerated, would attract the greatest rush of home seekers known to history.

The friendly attitude of tho administration is stimulating new thought on this great subject and it is the duty of every citizen to speedily inform himself upon the possibilities of doubling the productive territory of the United States. Let us, then, as proposed by President Roosevelt, conquer and reclaim this waiting, neglected empire.

The Beginning of Wisdom. It is not strange that under the stately elms of New Haven should flourish the friendly idea of tree culture, with the denuded hillsides of the beautiful Connecticut river as the objective point of restoration and improvement. The inhabitants of the Nutmeg State cannot fairly withhold their support of a National Irrigation Bill as may be seen by the following statement from a scientific authority at Yale:

"The arid and waste lands of Connecticut are to be reclaimed by scientific methods of tree culture. The cutting down of the Connecticut forests has left the rivers of the state dry in midsummer, thus shutting off water power for hundreds of factories. The restoration of the forests will have the effect of storing up moisture for the summer months. By cooling the air and acting as centers of precipation the treees will also aid in the distribution of the rainfall.

The new State law provides for a State park of several hundred acres, to be located near New Haven. In this park the Yale School of Forestry will plant trees by thousands, investigate the best species for transplanting in the State, develop methods of culture, and study the problems of insect extermination.

Pamphlets embodying the results of this study will be distributed free among the farmers and others in the State.

The new law provides that each town shall appoint a forest warden, who shall have care of the shade trees of the town. The towns are directed to make an annual appropriation for the setting out and maintaining of trees.

Strict laws for the protection of shade trees are included in the act passed last year. Any person who places an advertisement on a shade tree is liable to a fine os $60. A person who wantonly injures or destroys an oranamental or shade tree is liable to a fine of $100. If a horse in a public place destroys an oranamental shade tree his owner is to be fined $100, and must besides settle for the actual damage done."

If this course will be followed by other institutions of learning throughout the country education on the all important matter of Forrestry and Irrigation will have a creditable and unprejudiced beginning.

An Important Feature. In answer to a very general demand for primary instruction in irrigaticn for individual farming we have arranged to publish in regular installments through the year a detailed explanation of the principles and methods employed in lccating and establishing irrigation system on the farm, ranch or garden.

This valuable and timely information has been specially prepared for students homeseekers and small farmers by E. J. Wickson, Professor of Agricultural Practice, University of California, and Horticulturalist of the California Agricultural Experiment Station.

We recommend the careful study of Professor Wickson's instruction to the

general public, as well as students and practical farmers, for in no other way can such a desirable and fundamental knowledge of irrigation be obtained.

The first installment appears on page 16 of this number.

A Scientific Short-Cut. "Modern Mexico" that keen observer of the progress of events in the Land of the Sun, says suggestively:

"Irrigation has been practiced in many parts of Mexico for centuries, but within the last few years the use of iron and vitrified pipe has made it possible to put many acres under water that are inaccessible for the gravity ditch. Today many plans are in embryo for taking water over hills by means of syphons and reclaiming thousands of acres that could not be watered except at a prohibitive cost under the old systems.

There are innumerable oppportunities still to be found in Mexico where a moderate expenditure for the installation of an irrigation pipe line would quickly repay the outlay by bringing many added acres into sure and profitable production."

The irrigation canals and conduits of old Mexico stand as unexcelled monuments to the ambition and perseverance of the early Spanish invaders while the Aztec and prehistoric systems from which the conquerers gathered their ideas are marvelous achievements of engineering skill.

But tne laborious effort of countless slaves thro' the unknown centuries could not remove the stupendous mountains or span the yawning barrancas at their feet. And now comes science with a simple principle and a hollow tube and lo! by her magic the imprisoned waters of cloudland lakes hasten to thirsty valleys over hitherto unsurmountable walls of unyielding granite. The sun no longer levies tribute on the passing flood and the wavlng fields rejoice in the fulfilment of their desires.

The practical application of the syphon idea need not be confined to Mexico— and as it possesses some superior advantages in economy, facility and expediency should be seriously considered in a commercial light. We invite the opinions of practical irrigationists, experts and scientfic minds on the pipe line plan.

To Promote Education. Commenting on one of the tho thousand opportunities for development in the mountain territory up and down the Rockies a correspondent says:

"A ride over the stage line between Casa Grande and Florence does not bring to the view of the traveller many range cattle, but the occasional few seen are in excellent condition. The feed in the valley is very short, which forces the cattle into the hills at this season of the year. There is a valley, when the water development is brought about, as it must be ere long, that will be second to none in the southwest as a livestock section. Livestock farming will be the future, to a very large degree, of all the irrigated valleys of the southwest. That most succulent of forage crops—alfalfa, produces to perfection, and in no other way can it be so profitably disposed of as by feeding it to the cattle of the surrounding territory."

This is a common observation by travelers, always quick to see the possibilities of valley lands when well watered.

A well chosen committee representing colony enterprises in overcrowded cities would make the same report with the added force of official authority which would give their report an educational value of great importance.

Send out your committees, and let education begin.

STORY OF IRRIGATION

THE BEET SUGAR INDUSTRY IN THE ARKANSAS RIVER VALLEY OF EASTERN COLORADO.

By John E. Frost.

It was about 1870 when a young farmer from Bardolph, McDonough County, Illinois, still on the hither side of the meridian of life loaded his personal effects and his family into a covered wagon and started for the great west in search of a region where he hoped to find health and an opportunity to make a fortune. He crossed the Mississippi and then the Missouri River, pushed west through Kansas, following closely the line of the A. T. & S. F. Ry., which was then pushing its way through the Buffalo pastures of western Kansas towards the Colorado line in order to earn its land grant of three million acres within the time limit of the granting act.

This young farmer was Mr. George W. Swink, now State Senator Swink and Mayor of Rocky Ford. He pushed his way along the overland stage trail way ahead of the Santa Fe railroad construction to where the stage trail crosses the Arkansas River at a point where the rock bottom had given it the name of Rocky Ford. At this point he stopped and decided to locate. He built a small adobe house and store where for several years thereafter he kept a small stock of outfitting goods, and also furnished hotel accommodations to stage passengers whose love of adventure or search for fortune tempted them to seek a region then so remote.

Mr. Swink homesteaded land and commenced farming in a small way and with his few neighbors began the construction of a small irrigating canal, taking the water from the Arkansas River, which is now known as the Rocky Ford Canal, and which was the inception of irrigating operations in that region. About three years later the construction gangs of the Santa Fe Railway broke ground almost in Mr. Swink's door yard, and in a few months the great "Iron Trail" was completed to Pueblo, and Rocky Ford became one of its stations. An occasional new settler straggled in, a little more ground was put under cultivation each year, and thus was made a feeble beginning of farming in that part of the great Arkansas River valley, then a desert, but now the most productive and richest farming region of Colorado.

It was about twenty-five years later when the great wave of immigration and settlement produced by the period of unprecedented

railroad construction in Kansas reached the west line of that state in 1885, and it soon became evident that it was ready to flow over into Colorado if given a little timely aid.

Heretofore the efforts of the Santa Fe land department under the direction of Col. A. S. Johnson, land commissioner, and the writer, then chief clerk of the land department, had been directed wholly to the settlement of central and western Kansas along the line of the Santa Fe in the sale and development of its magnificent land grant, but it was becoming more plainly evident every day that great results could be secured in the peopling of the Santa Fe territory in eastern Colorado by giving it proper attention. With this thought in mind, but before any definite plans had been formed we were ready to handle the matter in a practical and consistent way when a small coterie of enterprising men who had been instrumental in the development of western Kansas and in close touch with Colorado interests, and who had been, as we were, close observers of the trend of immigration, came to us one day and suggested that we give them our co-operation in the work of starting a new town and of opening the fertile lands of the upper Arkansas valley in Colorado to settlement.

The leaders in this enterprise were Mr. J E. Golding, now president of the State Bank of Rocky Ford; Mr. I. R. Holmes, then local agent at Garden City, Kansas, of the Santa Fe land department for the sale of its western lands, now residing at LaPorte, Texas, and I believe Mayor of that thriving little city, and Hon. Robt. W. Steele, then a young Denver lawyer, now on the bench of the Colorado Supreme Court. They suggested that the time had come to start a new town in eastern Colorado, and after giving the matter careful thought we decided that the enterprise was a good one and very much in the interest of the Santa Fe Railroad Company, and after securing the approval of the Santa Fe management we gave the matter our hearty aid.

There was at that time in that region a large area of government land unoccupied and unused except for range cattle, which land we believed to be of a high degree of fertility and which we thought would be rapidly settled if the attention of the public were called to it and the way made easy for settlers to secure it.

The principal reason why the great multitude of settlers then locating in western Kansas had stopped short at the Colorado line was, in onr judgment, because the Uuited States land office for that district was located at Pueblo, 150 miles west of the line.

Practically all of these settlers came from the east and could make their entries for government land east of the line at Garden City, Kansas, but in order to make filings on the Colorado side they were obliged to go to Pueblo.

To remove this obsticle in the way of settlement we determined to locate a town thirty or forty miles over the line in Colorado and then to try to secure the erection of a new land distrit with the United States land office in the eastern part.

Accordingly a quarter section of land crossed by the A. T. & S.F. track was secured thirty miles over the line in Colorado and the town of Lamar located thereon.

Our plans prospered, the town of Lamar, within sixty days after the platting was completed, had a population of about 1,000 people, and many good business buildings and dwelling houses were started and rapidly pushed to completion. The members of the Colorado delegation in congress were quick to see the value of this move in its bearing upon the agricultural development of their state, and a bill was introduced in congress and promptly passed creating a new land district, and locating at Lamar the United States land office where entries could be made, and the great volume of immigration which then poured in exceeded our greatest expectations and resulted in the next few years in the construction of the magnificent systems of irrigation which now serve the fortunate farmers of that region,

Lamar is now a well built, prosperous little city of 2,500 people. At the time it was founded there were no irrigating ditches in that region except one or two small ones constructed by small farmers for private use, but farming up about Rocky Ford had been making good progress; the Rocky Ford canal had been enlarged and the Catlin Canal constructed and the little oasis started by Senator Swink had been constantly extending its borders and was already becoming known in Colorado.

Rocky Ford melons even then were eagerly sought for in the markets of Denver, Colorado Springs and Pueblo.

About a year after the inception of Lamar, Mr. Godding who had frequently spoken to me of the splendid farming advantages of the Rocky Ford region, over which he was wont to wax eloquent, induced me to make a trip to that point to meet Mr. Swink and to acquaint me with its splendid agricultural advantages with a view to platting a town and accelerating the development of that district. I then met for the first tme Senator Swink, the Nestor of that place, and now for years one of my most valued friends.

Rocky Ford was then merely a hamlet containing a few small dwelling houses and an adobe hotel and one or two small adobe store buildings, and a blacksmith shop.

I had never before made a personal inspection of the country there except from the car windows.

I was greatly impressed with it and was quickly convinced of its superb advantages and its great possibilities. Senator Swink owned

a large area of land surrounding the station and with his accustomed liberality and broad-mindedness he placed at our disposal whatever land we found necessary for the town site.

The platting of the townsite was commenced immediately and as soon as it was completed and an opportunity offered the public to secure lots therein a rapid and substantial growth commenced. A large number of new business houses and a greater number of neat and substantial dwellings were constructed and Senator Swink's long cherished dream of a thriving town and a prosperous cummunity was well strated towards realization. Capitalists came and made careful examination of the Rocky Ford district and upon that based their calculations of what could be done in the same line all along the fertile Arkansas River valley with adequate irrigating canals. The Oxford Ditch, the Lamar and La Junta Canal, the Holbrook Canal, the High Line and various other irrigation enterprises quickly took shape and and in the next few years were pushed to completion, until at this time the finest systems of irrigation in Colorado are in operation between Nepesta, the point where the Santa Fe crosses the Arkrnsas River above Rocky Ford, and the Kansas line.

The most important industry in the valley now well established, and which could have no foothold there but for these splendid irrigation systems, is the production of sugar beets and the manufacture of beet sugar.

In 1891 at the request of Mr. A. A. Robinson, then Vice President and General Manager of the Santa Fe Ry., (now president of the Mexican Central Ry.,) the writer, then land commissioner of the Santa Fe Ry., carefully investigated the beet sugar industry in the United States and made quite a full and exhaustive written report.

I had for some time previously given considerable attention to the matter and have ever since felt the deepest interest in it.

Several conferences were had with Messers. Swink and Godding on this subject and at my request these gentlemen attended a beet-sugar convention held some eight or nine years ago at Grand Island, Nebraska, for the purpose of getting information with a view to securing a beet sugar manufactory at Rocky Ford.

The superior melons, both water melons and cantaloupes, produced at Rocky Ford seemed to me indubitable evidence of the excellence of that soil and climate for products of a saccharine content and I hoped to secure the location of a beet sugar plant there. From the information secured at that convention Mr. Swink, who was as desirous as I of getting this industry located, told me that much to his regret he was forced to the conclusion that our region was not yet ready for it. There was not sdfficient land under cultivation and the farmers were not ready for it, but with the indomitable resolution so char-

acteristic of him he said, "we will commence at once to get ready," and he then proceeded to arrange for beet sugar seed and commenced experimentation personally and induced a large number of his friends to join him in the work.

His care and forethought bore fruit when several years afterwards the Oxnards, with whom he kept in touch, became ready to extend their operations, for when the American Beet Sugar Company was ready to locate its factory in the Arkansas River valley, of which the Oxnards made careful investigation as a result of Mr. Swink's efforts, the way had been made easy. The Arkansas valley farmers were ready and nothing was needed except to secure land and farmers' contracts for the requisite acreage of sugar beets, which Messrs. Swink and Golding and other of the leading spirits at Rocky Ford, Lamar and other points in the valley readily got, and the necessary shipping facilities and rates which the Santa Fe railway with the enterprise, business sagacity and cordial co-operation with the people of its territory, characteristic of its management, promptly supplied, and the present magnificent factory of the American Beet Sugar Company at Rocky Ford, costing over a million dollars and consuming daily a thousand tons of beets, was secured.

In 1900, the first year of its operation, 8000 acres of sugar beets were planted and the product consumed by this factory. In 1901 this area was increased to 12,000 acres and the limit of the present factory's capacity has now been reached.

At the last session of the Kansas legislature an act was passed providing for a bounty of a dollar a ton on sugar beets containing 12% or more of sugar, raised in the state. This wise measure has caused the farmers of western Kansas to give considerable attention to this new line of work and during the season of 1901 about 300 acres of beets were raised in western Kansas, mainly in the counties of Finney, Gray, Kearney and Hamilton and shipped to the Rocky Ford factory, which when the writer visited the factory last fall had shown about the same content of saccharine matter as those raised at Rocky Ford and Lamar, namely from 15 to 22%.

The beet sugar industry, although new, has now got well started and unless Congress should unwisly take off or reduce the duty upon sugar there is no question but that this industry will attain great proportions in the next few years, and it is ultimately not improbable that the United States will produce sufficient sugar to supply home comsumption instead of importing the larger portion to meet the home demand as is now the case.

The Havemeyer sugar trust is reported to be using all of its powerful influence to secure the removal of the present duty on sugar, or at least to get a very great reduction thereof.

It is to be hoped that they will not be successful in their efforts as their success in this would result in the crushing of an industry of great promise and of the highest importance to the agricultural interests of the country.

If congress makes no change in the present law it is a foregone conclusion that the American Beet Sugar Company will in the immediate future construct another factory of equal, or greater capacity than the one at Rocky Ford, at some point a little lower down in the valley, probably Lamar, or possibly as far down as Garden City, Kansas, and this will speedily be followed by similar plants in other locations.

A very interesting thing in connection with this subject is the fact that in Napoleon's time, when the sugar beet was introduced and its culture commenced early in the nineteenth century in France, the beets raised by the French farmers contained only about 5 per cent of sugar, and it is estimated that it cost about 15 cents per pound to manufacture beet sugar in France at that time.

It seems quite marvelous that as a result of the gradual breeding up and improvement of the sugar beet under improved methods of cultivation that the content of saccharine matter has been multiplied four or five times by the farmers of Western Kansas and eastern Colorado as compared with the results obtained by the French farmers at the time of the inception of the industry in France.

The present season sugar beets brought a return to the farmers who supplied the Rocky Ford factory of from $50.00 to $150.00 per acre.

From ten to thirty tons per acre are produced and the factory pays from $4 00 to $7.00 per ton, the price being governed by the sugar content of the beet.

The industry has proved quite profitable for the farmers, and the factory at Rocky Ford has added greatly to the growth and prosperity of that little city. It now has a population of nearly four thousand and the qalue of farming lands thereabout has doubled in the last two years. Senator Swink has lived to see the realization of the dream of his early manhood, and with it has come wealth to him as the largest land owner of that region, bringing the well merited reward of his steadfast faith, sound judgment, and hard, intelligent work.

There are no more prosperous communities in the west than those of this great valley of eastern Colorado.

Across the state line in Kansas the Arkansas River Valley is just as fertile as in Colorado, and with the object lesson presented at Rocky Ford, and the start given by the state bounty upon the production of sugar beets, this great industry will rapidly acquire a foothold there and it requires only ordinary business sagacity to see in the early

future the duplication of the Rocky Ford factory in several others of similar or greater capanity in the great valley between the Colorado line and Dodge City, Kansas, which region is now almost wholly given over to the production of alfalfa in connection with cattle interests.

The manufacture of beet sugar notches is very harmoniously and profitable with live stock interests. The pulp of the beets after the juice has been extracted being a valuable feed for cattle, sheep and hogs, is eagerly sought for by live stock producers where it is to be had.

The effect of the introduction of this industry into western Kansas upon the values of land therein the reader can conjecture by comparison with land values in the adjacent region where the industry is now firmly seated.

BALLADE OF LAST YEAR'S FISH.

Tell me now in what wave-worn way,
Under what sunken cedar tree,
Lies the trout that I had in play
Yestersummer—and saw go free?
Where's the one that rose to a bee—
Two pounds or better?—he, too, went clear!
Rede this riddle, too deep for me:
Where are the fish of yesteryear?

Gone to an honest rod, I pray,
With others to keep them company.
That no trout are astir today
Is all I know for a certainty,
This the picture of memory:
Rock and river and sky are here;
Even the same wild flowers I see
But where are the fish of yesteryear?

A year and a month have slipped away.
The river with ceaseless energy,
Has baitered the cānon's walls of gray;
But nought is changed to my scrutiny.
Cliffs with delicate drapery,
Sky and forest, rapid and mere . . .
But, O,—poetical mystery!—
Where are the fish of yesteryear?

L'Envoi.

Colonel, I'm hungry. I move that we
Spread the luncheon and pour the beer.
That will enliven this threnody—
Where are the fish of yesteryear?

Grand Marais, Aug. 15, 1901.

—*Chicago Tribune.*

ARTESIAN WELLS OF SOUTH DAKOTA.

By Prof. J. E. Todd.

The great flowing wells of South Dakota have attracted a world-wide interest. They stand unrivaled in the height of their pressure and the copiousness of their flow. The display of their power is so impressive that many have thought that some force not yet understood must be found to explain them. To one, however, familiar with the geology of the region and the common laws of hydraulics the principal facts are easily understood.

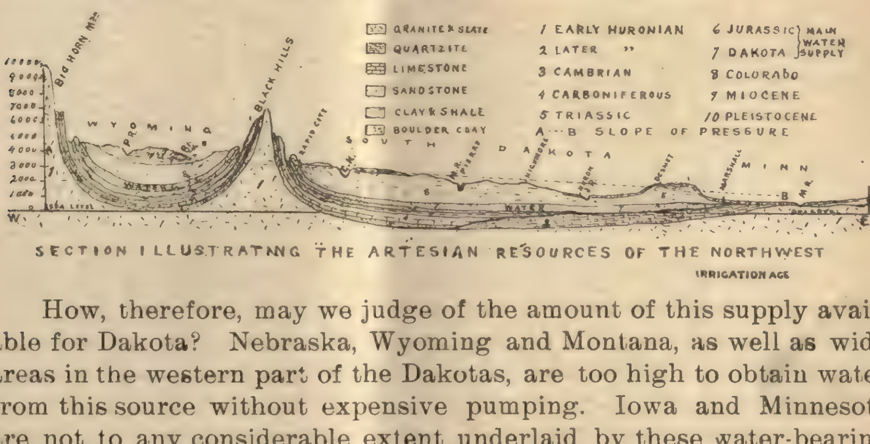
The immediate sources of the flowing waters are the different layers of sand or sandstone in the lower portions of the Cretaceous which with the intrrvening beds of clay comprise the so-called Dakota formation. Below it, also, and not clearly distinguished from it, are similar beds belonging to the Jurassic age. From these two formations, and mainly from the first, all the larger and deeper wells of Dakota derive their supply. The water comes up often with an immense power, 175 to 200 pounds per square inch. Why should it not have ere this burst forth and spent itself? The reply is that 400 to 1,000 feet of compact, heavy clay have been sufficient to hold it down. There are nevertheless a few places where natural breaks have occurred as along the Missouri river near Chamberlain and probably near Yankton and along the James river in Hutchinson county.

But our inquiry contemplates the original sources of the water. Whence does the rock receive its copious floods? The Dakota formation if considered by itself resembles a huge shallow trough extending indefinitely north and south, underlying the great plains. Its western edge of very irregular form lies exposed as foot hills along the eastern base of the main chain of the Rocky Mountains, also in similar ridges around the principal clusters of mountains further east. These exposures lie in an altitude of from 3,500 to 6,500 feet above the sea. Its eastern margin thins out to a ragged edge and is almost completely buried under later formations mainly by the boulder clay of the drift. It lies at an altitude of from 800 to 1,200 feet above the sea. Its upper portions are exposed along the Missouri river from Sioux City southward. With this conception one will readily understand, I think, how if water is turned into the porous substance of the formation until it is nearly filled to the top of its western edge, that if it is tapped from points of the surface only 1,300 feet above the sea as is the case in the

James River Valley, that water will burst forth with immense force. The efficient head may in some cases be nearly 500 feet above the surface.

Because of the unavoidable leakage along its eastern edge there is quite a regular decline of pressure toward the east. This from Highmore to Huron has been found to be about four feet per mile, and a similar grade appears to extend from Sheridan, Wyo., to Marshall, Minn. In some cases it is much steeper and shows also frequent irregularities. This leakage and the opening of wells must gradually exhaust the supply unless it is constantly replenished.

How is this water supplied? The ready answer is from three sources. First, by the absorption of rain falling directly upon the exposed edge of the Dakota and Jurassic formations. Second, that which seeps into these deformations from streams flowing over such exposures. Third, that which may pass into them from other formations below the surface, particularly from the underlying older formations. If these are equal to the water escaping from wells and springs and are unfailing, the supply of course may continue forever.



SECTION ILLUSTRATING THE ARTESIAN RESOURCES OF THE NORTHWEST

IRRIGATION AGE

How, therefore, may we judge of the amount of this supply available for Dakota? Nebraska, Wyoming and Montana, as well as wide areas in the western part of the Dakotas, are too high to obtain water from this source without expensive pumping. Iowa and Minnesota are not to any considerable extent underlaid by these water-bearing formations. Marshall, Minn., obtains water directly from it and possibly some shallow wells in the Red River Valley may do so indirectly, but many of them are known to be supplied from other sources. The Dakota formation doubtless underlies Assiniboia and the Saskatchewan valley, though it may not be so much a water-bearing formation as further south. Moreover, it lies deep there and other supplies of water are readily accessible. We, therefore, feel justified in estimating the adequacy of the supply available in Dakota as follows:

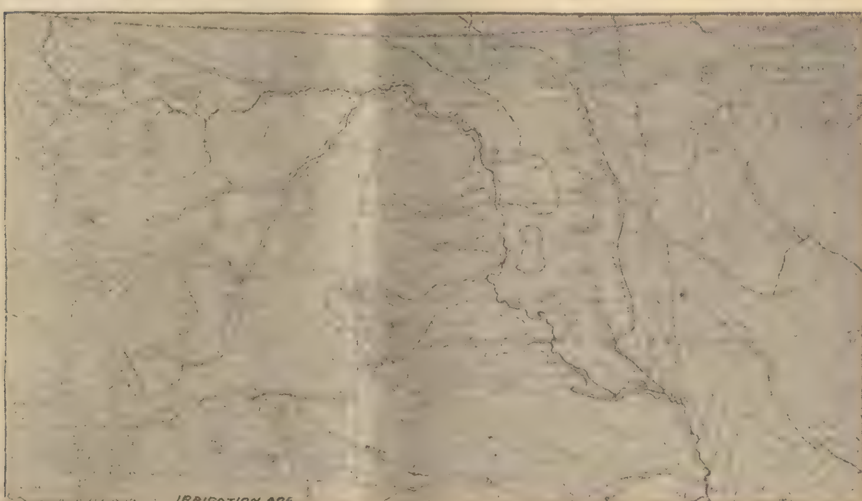
From geological maps we estimate the exposed surface of the Dakota and Jurassic formations between the north line of Colorado and Canada to be at least 3,000 square miles. The average rainfall reported in that region is twenty-four inches per annum. Supposing that one-

half finds its way into these porous strata, it would furnish 83,635,200,-000 cubic feet per annum. Col. Nettleton reported some time since that the Missouri river loses 834 cubic feet per second where it flows over the Dakota formation at Great Falls, Mont. It seems reasonable to suppose that from the North Platte, the Big Horn and the Yellowstone, there may be twice as much more derived. If we allow the score or more of smaller streams around the Black Hills and the Big Horn Mountains to offset the possible overestimate, we would still by this calculation have 77,103,072,000 cubic feet furnished in addition. This would afford water sufficient to supply more than ten times that at present derived from all the artesian wells in South Dakota. Moreover, if, as seems to be very probable, the rainfall sinking into the older formation makes its way eventually into the Dakota and Jurassic, and if we estimate that one-fourth of the total rainfall upon their exposed surface is so transferred, we may reasonably double the amount given above. Besides these annual supplies there is what may be called a *stored supply*, which has been accumulated in the water-bearing formations at such an altitude above the mouth of the wells that should the regular supplies cease it would sustain the flow of the wells for considerable time. From the map and section subjoined it may be readily seen that extensive areas in Montana and Wyoming may lie at an altitude sufficient to accomplish this result. Since the water-bearing layers of the Dakota and Jurassic have an average thickness of 300 feet and the sand may contain at least one tenth of its volume of water, it would represent an equivalent to a lake 30 feet in depth extending over the whole area underlaid by these formations. Of course over most of the region so underlaid it would be obtained only by pumping, but ezery square mile lying at an altitude higher than the surface of the James River Valley might contribute through the wells, water sufficient to cover a square mile in the James River Valley one foot deep per year for thirty years.

In order to verify these calculations many and difficult observations extending over wide regions and for a series of years will be necessary. It is hoped that the United States geological survey and that of South Dakota may undertake to place our knowledge concerning this most important supply upon more reliable basis as soon as practicable.

Concerning the permanence of the supply, we call attention to the following facts: Although the supply is doubtless capable of being exhausted, if too mrny wells are sunk, there is abundant reason for believing that it is much less so than most natural resources. Water is not destroyed by its use and its supplies are constantly accumulating. Its deposits are from the nature of the case more easily calculated and its decline more easily observed and more certainly determined.

Moreover, this decline will be regular and slow, so that it may be intelligently studied and regulated. We do not know the amount of leakage nor of the annual supply and much less the amount of the stored reserve, yet from the nature of the case, from the principles of hydro dynamics involved. and the nature and extent of the formations bearing water, we may rest assured that the decline will be very gradual. The first signs of diminution will be the stoppage of the weakest wells, those on highest levels or near the margin of the area. If a well has a pressure of 170 pounds and has gradually diminished five pounds within a year without having any wells sunk in its vicinity we may safely calculate that under the same conditions it will last for at least 35 years with a gradually diminishing flow. The multiplication of wells in a vicinity is the severest test of the amount available at that point and the rate at which it is being exhausted. Where such multiplication has taken place it is still a question in most localities whether perceptible diminution of pressure has resulted or not.



In closing we would emphasize especially the importance of the establishment of a system of careful and prolonged observations upon representative wells throughout the region. From data so collected we may hope to arrive at a reasonable and most efficient method of regulating both the number and management of wells, that this most valuable resource may be utilized to the greatest advantage and for the longest period possible.

IRRIGATION IN FIELD AND GARDEN.

BY PROFESSOR E. J. WICKSON.

Irrigation should be recognized as an agricultural art of very wide applicability and value. Its association with the idea of desert reclamation has blinded the public mind to its value for regions where the need of reclamation does not exist. Irrigation is a means of soil improvement to be employed, like other means of improvement, when the soil needs it. Water is the most important food of plants, not alone because it enters in such volume into their tissues, but because without it in adequate amount the plant can not use other foods in sufficient quantity. No one questions the wisdom of the saving and storing of manures, nor the wisdom of generous outlay for commercial fertilizers when required. The same is true of soil improvement by means of drainage. There should be a similar feeling in regard to irrigation.

The most diligent culture and the most generous fertilization are often made of no avail, and actual loss is sometimes incurred because the farmer has not prepared himself to supply water when needed. The water, which he could often provide for a mere fraction of his expenditure for fertilizers, often for less annual cost than the interest on his investment in underdrainage, he has neglected to have ready for use, and he sees the hope of return for his year's labor and expenditure fade away during a few weeks of drought. There have been cases where water has been stored at considerable expense as a protection against fire in barns and has remained unused while some valuable crop was burning up in the garden. Such losses are largely due to two things: First, the notion that irrigation is of importance only in arid regions: and, second, ignorance of the ease and cheapness with which a farm water supply can be stored and distributed. It is very important that the value and availability of water for irrigation should be recognized and a supply provided on each farm.

Irrigation, moreover, is not merely a recourse to insure the safety of a crop. It has been demonstrated beyond question both by practical experience and by systematic experiment that growth and production can be profitably pushed by irrigation even when the natural moisture seems ample, and in this respect irrigation aligns itself with fertilization and cultivation as a factor in intensive culture.

Another error grows out of the large scale upon which irrigation is generally known to be carried on, involving canals and ditches too

expensive for individual undertaking. The impression is made that considerable capital and engineering skill are necessary to success; but as a matter of fact proftable irrigation is easily obtainable by small effort. It lends itself readily to small individual or co-operative undertaking, developing water whose presence may be almost unsuspected, or utilizing water which ordinarily is either wasted or is a positive detriment when not turned to profitable service. It is the purpose of this bulletin to present suggestions for irrigation of this kind.

Small irrigation works usually require neither greater skill, labor nor outlay than other farm improvements which are readily undertaken. They do not require as exect engineering as underdrainage by tiling, and the whole system, both for development and storage of water, often costs much less per acre of the area irrigated than does tiling. The work is more readily comparable to the construction of open drains, coupled in some cases with reservoir building, which is no more difficult than cellar excavation and is accomplished with a similar outfit of teams, plows and scrapers. The man of ordinary skill in handling these tools, who can turn a straight furrow or build a straight piece of fence, and can do these things well, needs only a suggestion of the feasibility of securing a home water supply for irrigation, providing his conditions are favorable.

The first thing to be done in all cases is to make a careful study of the whole situation, the location of the water supply, the lay of the land, and its requirements of water, etc.

DETERMINING LEVELS.

A fundamental requirement in irrigation on whatever scale is the determination of grades and levels. On small-scale irrigation works such approximation as can be secured by careful use of very simple appliances answers the purpose very well. Although the surveyors level is desirable, this can be dispensed with by using the simple sighting levels described in books on drainago, and even these are not essential, for a home-made appliance can be made to give satisfactory results. Such a device is described below, which, although in constant use in some parts of the country, does not seem to be widely known. It will be found useful in nearly all kinds of farm engineering where the location of grades and levels is necessary and no special hindrances intervene, but it must be borne in mind that its usefulness depends entirely upon the care with which it is operated.

The use of a leveling triangle (fig. 1) was suggested to small irrigators in California many years ago by a prominent irrigation engineer, Mr. C. E. Grunsky, of San Francisco. It is constructed in this way:

The three pieces A B, B C, and C A are made fast to each other

at A, B, and C. The board B D is fastened to the triangle at right angles to A C. An ordinary carpenter's square used in the construc-

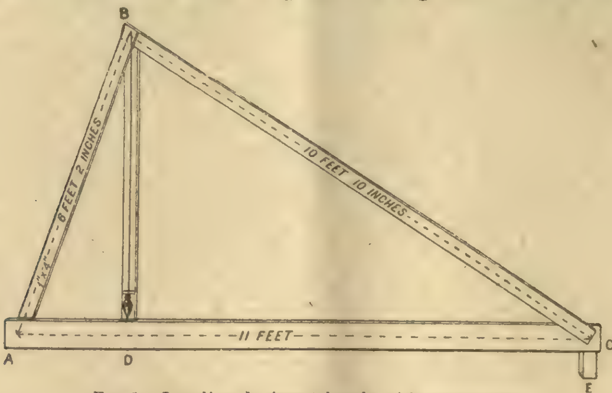


FIG. 1.—Leveling device—triangle with plumb bob.

tion of the apparatus will insure sufficient accuracy in the position of B D. Near B, on the board B D, a plumb line is made fast. The plumb bob, like a mason's plumb bob, hangs in a hole, so that when B D is vertical the string hangs very near the surface of the board B D. When B D is exactly vertical A C is exactly horizontal, if the angles at D are true right angles.

The dimensions of the triangles may be about a follows: A C, 12 feet long; A B, about 7 feet 3 inches; C B, about 10 feet; and B D, about 6 feet long. Other dimensions will do as well, the essential features being the straight board A C and the board B D at right angles to it and near enough to one end of A C for the man carrying that end of the triangle to see accurately the position of the plumb line. The board B D should not be less than 4 feet long, or the plumb line will be too short to give satisfactory results. It will frequently be found convenient to have a scale of feet marked off on A C.

In marking on the board B D the line in which the plumb line will hang when A C is exactly horizontal considerable care is required. Two pegs are driven into the ground ar far apart as A and C for these points to rest on. The highest one is driven into the ground until the plumb line follows about the center line of the board B D. Having marked this position of the plumb line, the triange is reversed so that the end B rests on the peg where before we had the end C, and vice versa. Should the plumb line make an angle with the first line marked on the board, then the correct position will be exactly in the middle between these two lines. This point should be permanently marked on the board B D; in using the triangle when the plumb line passes through this point the base of the triangle will be level.

DETERMINATION OF LINE OF A DITCH.

To use this instrument for locating the line of the ditch, calculate

the amount which the grade should rise in a distance equal to the length of the base of the triangle to secure the fall which is best to convey the water, according to character of soil, etc., a matter which will be discussed later. Under one end of the base fasten a small block with a thickness equal to the desired rise. Below is given a table, showing the thickness of blocks which should be used on triangles of different lengths to give various grades.

Amount of fall secured and thickness of blocks required with triangles of several lengths.[1]

Length of base of triangle	Thickness of blocks, being the amount of fall for different triangles and for different grades, per mile.						
	4-foot grade	5-foot grade	6-foot grade.	7-foot grade	8-foot grade	9-foot grade.	10-foot grade.
Feet	*Inch.*	*Inch*	*Inch*	*Inch.*	*Inch*	*Inch*	*Inch.*
10	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$
11	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$
12	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$
15	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{5}{16}$
16	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$
$16\frac{1}{2}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$

[1] The numbers 4 to 10 at the head of the columns are the number of feet of fall in the ditches per mile of length The fractions below these numbers give in inches the fall which must be allowed in the length of the triangle. These are correct to the nearest one-sixteenth of an inch

When a block of required thickness to give the desired grade has been fastened to the triangle, drive a peg at the starting point with its top, say, 6 inches from the proposed bottom of the ditch. Place the end of the leveling apparatus under which the block is fastened upon this peg with the other end pointing in the general direction from which the ditch is to come. The bottom of the block must rest upon the top of the peg. Bring the apparatus to a level and set a peg 6 inches long so that its top just touches the bottom of the forward end of the apparatus. The lower end of this last peg will then mark the bottom of the proposed ditch. This operation will be simplified by putting a leg just 6 inches long upon the forward end of the triangle. It will then be only necessary to swing the triangle around until the base is level, when this leg will rest upon the bottom of the proposed ditch. Drive a peg here, which will, like the first, be 6 inches high from the ditch bottom, carry the triangle forward to this peg, and proceed as before.

Contour lines for checks or distributing ditches can be located wtth the aid of the triangle. To locate a contour line (a line passing through points of equal elevation), as required in the construction of a check levee, drive a peg until its top has a convenient elevation from the ground, say 1 foot. Put a leg of equal length on one end of the triangle and rest the other end on the peg, then swing the triangle around until the plumb line shows the base to be level. At this point drive a second peg and proceed as before. If the pegs are driven so

that the tops are at the heighth of the proposed levee they may be retained as grade stakes as well as line stake for the embankment.

To find a point in the next contour line below, on which a check levee should be raised so that its embankment will hold back the water to the base of the higher one, begin with the end A at the base of the upper levee and level the triangle in the direction of the proposed levee, measure the distance from the end C to the surface; from this point use the triangle again in the same way and repeat the operation until the sum of all the measurements made from C to the surface is equal to the height of the levee it is intended to construct. Having thus found a starting point for the second contour line proceed to locate this line as before.

It is obvious that the triangle is most serviceable in determining grades on land which has considerable slope, because more appreciable differences in grade will be noted in each use of its length. The difficulty of reaching correct conclusions as to the best position for a ditch or contour check increases as a rule, with the flattening out of the surface. But the use of the triangle is only recommended for small scale work in the absence of more accurate instruments, and under such conditions it is very serviceable.

To be Continued.

HAIL FOLLY!

On a day I met with Folly,
Knowing not a flirt was she;
She was piquant, she was jolly,
And she thrust out melancholy
With a smile of witchery.
I, supine, could not disarm her,
Though I guessed in some degree
There was mischief in my charmer,
So it came about, you see,
Folly made a fool of me!

Folly tired of her adorer
When her slave I came to be,
Scoffing at the love I bore her,
Vexed because I boldly wore her
Too familiar livery.
Petulant, she scourged and left me
Shorn of all my panoply.
So it was when she bereft me
Of her smile, she set me free—
Folly made a man of me!

—*Frank Roe Batchelder in January Smart Set.*

IRRIGATION IN CHINA.

By M. R. Jefferds, C. E.

Since the year 2627 B. C.—ten years after the accession to the throne of Hoangti—or 4523 years ago, the Chinese are known to have irrigated their lands for agriecltural purposes.

Small plats of land of from two mow upwards (a mow is one-sixth of an American acre), were made level and ditches put through and around them in such a manner that when the ground was wet enough the surplus water could be let into the adjoining patch, which, as a general thing would be from six inches to one foot below the level of the first. Thus through the great plain of China patches or strips of land may be seen, one a trifle above the other, made so artificially for the purpose of utilizing a single water course to the greatest possible advantage. Archimedian pumps are used in some places to raise the water from the creeks and rivers, in other places aud to a greater ex tent, troughs about fifteen inches wide, with four inch sides, are used At each end of these troughs there is a revolving shaft with ratchet wheels, over which pass an endless belt, with conveyors or buckets about a Chinese foot (fourteen inches) apart. The shaft of the upper ratchet wheel is attached to an upright shaft, which is made to revolve by animal power, buffaloes being used.

The most common way of raising water for irrigating purposes, however, is by hand. Two children are placed on the bank of a stream each with a rope about five feet long; one end of each of these ropes is attached to a bucket of about four gallons capacity. The bubket is dropped into the water and filled; then with a horizontal pull on each side it is raised to the distributing tank and emptied.

I have frequently seen two girls thus at work raise from sixty to eighty gallons of water per minute. Passing along the various water courses (and here I may say that all of the water courses are frequented by sampans—a sampan is a small boat, a trifle larger than our skiff) and the streams that are large enough, by junks that are used for the purpose of transporting materials to and from the interior the same as we send produce by wagon (there are no wagon roads in the country), there may be seen in the dry season hundreds of boys and girls at work from early morn until dewy eve raising the water to the irrigating ditches, which water could just as well and better, too, be raised by wind if they understood our methods of utilizing that kind of a motor. In mountainous districts, of course, they can and do divert the course of the streams into the irrigating ditches by making

small dams, but on the great plain of China this cannot be done. It is not well understood by us, and I may add by people from other countries, that a large portion of China is a rich alluvial plain. By drawing a line from Hang Chow on the 120th meridian and about 15 minutes north of the 30th parallel to the 114th meridian, about 30 minutes south of the same parallel, thence south to the 28th parallel, thence west to the 111th meridian, thence north to the 31st parallel, thence east to the 114th meridian, thence north to the 40th parallel, thence east to the 114th meridian, thence southwest to the place of beginning, comprising an area of over 250,000 square miles, will be found the alluvial or level portion of China, which is irrigated by lifting water principally by hand. There are in this vast area thousands of acres of land that lie under water a great portion of the year, and are therefore, not cultivated. At a small expense these lands could be reclaimed, and with the use of American wind-mills made available. There are wind-mills in China. such as they are, but it would hardly be a sin to worship them, as they are not in the likeness of anything on the face of the earth, the heavens above or in the waters beneath. What China requires is an invasion of modern appliances to help their millions of people, who are, as a whole, quiet, domesticated and gifted with infinite perseverance, industry and sobriety, together with patience and endurance beyond comprehension. Our modern system of irrigation would save them millions. There are no power mills for grinding grain in that country. When rice flour or cornmeal is wanted they resort to hand grinding, which is done with two stone wheels, about thirty inches in diameter and eight inches wide, which are attached to a horizontal shaft about three feet in length. This shaft works on a pivot set in the center of a thick stone about five feet in diameter, upon which the two wheels roll. These wheels are propelled by girls, who grind the grain to the proper consistency for culinary purposes. All industries in China are carried on in the most primitive manner, and will never be changed from within, as the genius for inventing has never been developed and never will be without an inducement such as protection, by patents or premiums from the government would give. The field is open for American manufacturers if they will but send their agents there with examples of their goods and wares, that the Chinamen may know from ocular demonstration that the things they are told about do really exist. Printed descriptions and illustrated catalogues are of no use in China. It is a waste of time and money to send them there.

To send samples to established houses in the treaty ports of China means to hide our lights under a bushel, as there are few, if any purely American houses there, and other foreign houses always press their home productions in preference to all others. This, of course, is nat-

ural, and therefore right, but it is not healthy for our American manufacturers.

As before stated all industries in China are carried on in the most primitive way and will be for many years to come. The civilization of Eastern Nations is founded upon the family and not based upon the individual as in America. This difference is much greater than one would imagine and its consequences are not only far reaching, but are almost immutable. A father teaches his children his own trade and seldom permits them to learn any other. There are many industries in the country that have belonged to the same family for over 3,000 years, and they do their work to-day the same as their ancestors did before the Christian era. Companies or corporation, as we understand them, are unknown to the orientals except where they have been forced upon them by foreign nations. As a result in their industrial systems there is no dividing and distributing of the functions of manufacture among a mass of men. It is a well-known fact that "the cobbler is the bootmaker, and starts with the raw leather, and works until he has completed the finished boot or shoe. In working silk the man and his relatives and slaves will even begin with the silk-worm and mulberry leaf and toil in every stage until a roll of silk has been produced for the store." The same principle applies to the distribution of merchandise. It is true the Orientals are very skillful. Give them a type-writing machine, no matter how complicated, and they will reproduce it with absolute accuracy. The reproduction will be done by a man and his family, sons and grandsons, or possibly sons, brothers, nephews, etc. They can reproduce one machine, but they cannot reproduce a dozen at the same time. If it takes a month to reproduce one it will take one year to reproduce twelve. This is one reason why the east cannot compete with us westerners

On the other hand, as Dr. Bedloe, late U. S. consul to Ammoy, China, very tersely puts it, "The Chinese have not that wonderful training and technical knowledge of our own artisans. Take the sewing machine for an example: The iron of the framework is of one grade of metal, the rod between the treadles and the wheel is of a second, of the pin upon the wheel a third, of the finely cast piece above the board a fourth, of the sliding bar a fifth, of the sliding plate a sixth, of the needle a seventh, of the hook an eighth, and of minor parts four or five more. Our artisan selects the form of iron which is suited to the purpose for which it is employed. One variety must resist shaping, another percussion. One must resist tensile strains, and another strains of compression. All this demands an immense amount of knowledge, of which the oriental artisan has little or nothing. If you give your sporting rifle to an Oriental machinist to be repaired, he is liable to put a soft, ductile steelin for a new trigger, and a

piece of very brittle metal for the hammer. In every trade, therefore, involving the manufacture of goods, such as the sewing machine, the bicycle, fine machinery, the making of pure chemicals, the making of novel and varied designs in textures, the Orient can never compete successfully with the Occident.

The Orient can compete where merely brute labor unaccompanied by intelligence is required. In the production of raw sugar, in the mining of coal, the growing of rice, millet and cotton, in the raising of silk-worms, the production of tea, they have always had, have to day and will have for an indefinite period an advantage over us, if it be an advantage.

"We may stop this advantage by a tariff, but it is not a protective tariff in the true sense of the word, any more than would be a tariff upon pine-apples, mangoes, bananas and other fruits which will not grow in our land. The reason why our commerce in the east has not kept pace with our trade and commerce with all other fields is due chiefly to our thoughtlessness. A New York exporter, a Philadelphia manufacturers, a Chicago merchant sends his price current and his illustrated catalogue to a house in Canada, South America and West Indies or Europe. There they are understood. The words and the drawings give fair concrete ideas of the wares and goods, and trade is started. The business man sends the same publication to the east where such things have never been used, where in most towns outside of the treaty ports there are no postoffices, no reading rooms, no chambers of commerce or mercantile exchanges. There our drawings appear just as ridiculous to natives as theirs do to us, and our price-list, by its very candor, is regarded by them as a fraud and a swindle upon its face. What is needed is to send our first-class men to that part of the world. We should also establish in the east industrial exhibitions of moderate dimensions and should establish a trade literature in both English and the language of the land where the publications are to circulate. In this way a commerce with the Orient could be built up which would bring wealth, in hundreds of millions per annum, to the United States."

I do not know of a romance of late years that has been so generally taken up by the press as a truth, credited by the people as a fact, and looked upon by a business men as a reality, as the canard published a few months ago by the San Francisco *Report* called "the invasion of the United States by the manufacturers and producers of China and Japan." Even with improved methods of utilizing the same, and all the genius that their power of comprehension can command, it will be many, many years before the Orientals reach a point when they will become inventors or even proficient imitators. Before our industries will be effected to any appre-

ciable extent even then millions of dollars must be expended in machinery, thousands of operators must be taught and generations must go and come. The only advantage Oriental countries have over us now is the advantage accorded them by the United States laws that make the dollar they earn worth only half as much as the dollar that our operators earn, while their dollar will buy more and with it they can live better, have more work, and lay eside more money than we can do with our dollar.

'TIS STRANGE.

'Tis strange how fashion makes us change
the objects we admire;
We used to sing the tireless steed but now
the steedless tire.
So Otto bought an auto, so as not to be
antique
But the thing was autocratic,
As well as automatic,
And the auto wouldn't auto as it
ought to, so to speak.

He thought to get an auto-operator for the
work,
And first he tried a circus man, and then
he tried a Turk.
For he knew a circus man drove fifty
horses with success.
And if a man be shifty
Enough to manage fifty,
It's palpable enough he ought to be able
to manage one horse-less

As for the Turk, 'tis also plain, deny it if
you can,
He ought to run an auto since a Turk's an
Otto man.
'Twas all no use, so Otto moved to Alabama, purely
That he might say: "I'm Otto from
Mobile and my motto:
'A Mobile Otto run an auto-mobile,
surely.' "

Then Otto sought to auto on the auto as
he ought to,
But the auto sought to auto as Otto never
thought to,
So Otto, he got hot, oh very hot; as he
ought not to,
And Otto said. "This auto ought to auto.
and its got to."
And Otto fought the auto and the auto it
fought Otto,
Till the auto also got too hot to auto as it
ought to.
And then, great Scott, the auto shot to
heaven—so did Otto—
Where Otto's auto autos now as Otto's
auto ought to.

—*F. V. Cook in Smart Set.*

THE RECLAMATION OF THE ARID RIGION.

PORTION OF ADDRESS OF R. S. FULTON BEFORE AMERICAN FORESTRY ASSOCIATION. DENVER, AUG. 27, 1901.

When we were children we used to sing "Uncle Sam is Rich Enough to Buy Us All a Farm," and this consciousness was a safety valve for all the discontent and envy arising from deprivation and hardship among the poor. The public lands were open and the tinker and the tailor, the bookkeeper and the barber, the laborer and his sons knew that if worst came to worst they could go west and find a quarter-section and make a home on it. Who can tell what misery, what riots, what anarchy, what class hatred we have escaped through this happy condition. But all that is a thing of the past now. The safety valve is closed.

The tillable land is exhausted and the prairie schooner no longer fiits across the country with a family aboard hunting for a claim to settle on. The need is greater than ever before because the whole Middle West and even Iowa and Kansas are as thickly settled as New York and New England were when they sent their sons and deughters out to fill up Ohio, Kentucky, and the Mississippi Valley. Then the home-seekers came out of a small fraction of territory compared with that which is swarming to-day. All New England, the Atlantic States, the whole Mississippi Valley, clear to the foot of the Rocky Mountains is dotted with school houses full of children who in twenty years must have homes of their own.

Where shall they go? Shall they crowd out their older brothers on the farms or take lower wages and longer hours in the coal mine or the factory in order to get places at all? Who can think of such an alternative, with its privations, its struggles for a chance to labor, its strikes against hard conditions, without casting about for some relief. Who can calculate the strain upon republican institutions when the hungry poor have no place to go and have the extravagance of the rich flaunted constantly in their faces?

Only divine intelligence could foretell the many ways in which the upbuilding of the West will benefit the rest of the union. The vast sums spent in attempting to control the floods of the Mississippi would be largely saved because foresting the vacant lands, storing the win-

ter floods and soaking the dry plains with surplus water would go a long way toward preventing the yearly peril. The present system is going from bad to worse for already the bottom of the river is higher than miles of farms and thousands of houses, and every dollar spent in piling up levees makes higher and increases the danger.

Settlements develop mining as well as other industries, thus still further stimulating the demand for machinery, tools, powder, etc., which reaches all over the East. Every farm will be within reach of the hills that everywhere contain prospects, and the yonng men will go there instead of fiddling their time away. They can work in a nice warm tunnel all through the storms of winter, piling up ore that can be hauled to mill when the roads open, and are likely at any stroke of the pick to discover a valuable mine, and a good mine is the greatest market maker in the world. The work itself requires immense outlays for labor, machinery, and supplies of all kinds, to say nothing of the population it always attracts, in the way of traders, professional men, and non-combatants of every kind. The miner is always a good liver and has no use for money except to spend it, and a mining communty consumes more of the good things of life, per capita, than any other class of men. They send out the cash for everything they eat drink, or wear, and it all has to be carried to them. They afford an excellent outlet for all the farm produce that can be raised and thus build up towns and villages in the valleys, making opportunities for professional and business men, which in turn draw upon the great trading centers of the older states.

The arid states are already valuable customers for their neighbors east of them, and when it is considered that a population fifty or a hundred times as great would not crowd them at all, their value as future allies can be imagined.

The interchange of commerce has been the greatest incentive to ambition in all ages that the world has known, and today it is the dominating force, stronger than any other human passion. Wars have been waged and millions of lives sacrificed for the possession of this, that, or the other market, by the commercial nations. What war would give us a field for enterprise and commerce equal to this western world of ours? And this we have with no need of conquest. Only the tenderest ties exist between us. No bloodshed is necessary to secure it, no misery to follow its possession, no enemies to overcome. It is ours and it is the richest portion of the globe left undeveloped. It has advantages unequaled in many respects for there is no such thing as missing a crop, there is no lack of a ready market, no fever swamps, no plague or cholera but the sunniest, happiest and most healthful land that lies outdoors, with conditions that train up a noble race of men and women who will build an empire in the West such as their fathers did iu the East, and endow it with a high and splendid growth of American civilization.

The adoption of an adequate policy to secure such splendid results would be a fitting opening for the twentieth century.

AGRICULTURAL SCIENCE.

By H. W. Campbell.

There are many people today who have heard the simple idea of scientific agriculture ridiculed. In years gone by it was more commonly called book farming. The writer well remembers fully thirty years ago a middle aged man who had a farm and other property left to him by a relative. He started out to show people in that neighborhood how to farm. He first secured a large number of books on general farm topics, both American and foreign, as well as ancient productions, and of course he did as his neighbors predicted, made a total failure of everything. But did he go at it scientifically? No, sir. He went at it entirely devoid of understanding. He would not listen to suggestions by his neighbors. He was going to introduce something wonderful into that neighborhood, and that something he knew absolutely nothing about.

A very similar incident was related to us while recently visiting the various irrigating districts in Colorado. One of those commonly called "smart Alecks," with some money, bought a farm with a water right, and was "just going to show those Colorado people how to irrigate and grow big crops." When he began work he was kindly told that he would make a failure, but he replied that his money bought the farm, and with a sarcastic wink said, "he would show them a thing or two." But the poor, conceited fellow vanished financially and bodily in a few months. These are certainly extremes for illustrations, but there are far too many of the same character, and they recal to mind a word of warning from the good old Book, Prov. xiii:18: "Poverty and shame be to him that refuseth instruction, but he that regardeth reproof shall be honored." In all our wide and varied experience we cannot recall an instance where this passage has not proved true. The point we wish to make from the above is that conceited agricultral theory when carried into practice has almost invariably proved to be a pauperizing delusion, while science, as given by Webster, embraces those branches of knowledge which give a positive statement of truth as founded in the nature of things, or established by observation and experience, and it is this kind of scientific agricultura information that the average western farmer not only needs but must have. Now hold on, kind reader; don't think for a moment that we look upon the average farmer as an ignoramus. No, sir. We have met too many of the western farmers in our extended travels to

harbor even the shadow of such an idea; furthermore, the writer has been one of them for the past sixteen years. The difficulty is right here. The western farmer has quite recently been presented with a problem of unusual complications and importance; in fact, so forcibly has it been presented to some of us of late that we have grasped at seemingly floating straws, with a hope that some idea might be found that would lead to the general solution of this perplexing and all-important problem. Thanks to a kind Providence, some of us have discovered ideas that are fast solving this problem, that of growing crops absolutely every year in paying quantities right on the face of this great American desert.

The early history of the country now so commonly known as the dry belt is too well known to need repeating. Suffice it to say that about twelve years ago the greater part of it was looked upon as the garden spot of this country. The seasons were very favorable, prices were fair, and everyone seemed destined to prosperity of the most flattering nature. It mattered little how the crops were put into the virgin soil, the yield was invariably many fold. Then came a few seasons of peculiar conditions, which led many farmers to theorize that poorer tillage brought as good if not better crops. Then poor farming was thoroughly tried and all good qualities of the country, farmers and everything pertaining to them seemed to vanish almost in one season. Then came the artificial rain fakir. It was another floating straw; he said he had a secret; that if the poor, deluded creatures only understood they could have rain at will. He had had experience; he pictured the wonderful fertility of soil, and then, with plenty of rain, the heavily laden fields. He wanted money, and the people wanted rain. He got their money and they got experience.

During all these puzzling days our attention was frequently drawn to agricultural science, and today you can see its mighty work developing all over this great country in all its various branches. Much is being developed in the various branches of dairying, breeding and fattening of stock, etc., and any man who can look back thirty years and recall the marked advancement from east to west along these lines can but say with amazement, What will the next thirty years develop?

The more recent sciences and of more vital importance to the west are artesian irrigation; irrigation from rivers and windmill irrigation; last, but not least, the science of soil tillage. To the latter is due more consideration than the average man is willing to admit. It is largely through this branch of agricultural science that irrigation achieves its greatest success. It is through this branch of science that general prosperity must return to the major part of the so-called dry belt. It is the science of soil tillage that will make the great, broad sub-humid belt the most beautiful portion of this great United States.

Beautiful, did we say? Yes, because Webster says "beautiful implies all the higher qualities which delight the taste and imagination."

Look at the remarkable stride science has made in developing the wonders of almost all other branches of nature's great work. Electricity, for instance, under the generalship of Edison, Bell and others. It has got to where we are ready to believe almost any statement relative to its achievements. The first attempt to conduct power by electricity through the medium of a wire was a crude affair, though it was accomplished; but look at it today! When harnessed to the falls of Niagara, a marvel of wonder.

Look at surgery today. Has science done anything for it in recent years? Let one of our expert surgeons of thirty years ago be passed at once to the present time, and he would stand in profound awe of the marvelous works of scientific surgery of today.

Look inside the large factories today and note the changes and improvements. Take, for instance, that great labor-saving machine, the harvester and binder, which costs a very small per cent. of what it cost twenty years ago. Take one piece, the cutter-bar. We are told that one man turns out as much work in one day by the use of scientifically improved machinery as sixty men could do when first they began the work. Now let us glance at agricultural science, more especially the fundamental principles that underlie the whole work—that of soil tillage, for upon the quantity and quality of the product of the soil depends our success. While the general success of our entire country depends upon the ultimate success of agriculture, yet, until within a very few years this great science has been sorely and sadly neglected. We, as a nation, boast of being progressive; yet in the science of agriculture, especially that of soil tillage, we are far behind the mother countries. Don't think for a moment, kind reader, that there are no developments along this line. Prof. F. H. King, of Wisconsin, Prof. Milton Whitney, of New Jersey, Prof. H. R. Hilton, of Kansas, and a few others, have made some wonderful developments in the recent years, and today it has first place at most of our agricultural colleges. Farmers all over the west are now thoroughly awake to its importance. Individual farmers are experimenting. Railroads, mortgage loan companies, bankers, in fact all local and general interests throughout the entire west are taking up the subjectf and some phenomenal results will materialize this year. General farming on scientific principles is rapidly coming to the front. Get into the procession, reader. The real merits and values of the west as a general farming country are just becoming known. Many people seem to think the west of today has had an unwarranted boom, and must now go back to stock and the ranchman. It was only a flurry in proportion to a blizzard or a gentle zephyr in proportion to a cyclone

as compared to what is coming. That boom was based on wind, speculation and theory, without any practical knowiedge of the country or its conditions, while the present move is based on firm scientific agricultural principles. We are now beginning to know the soil, the climate, and their relation to each other, as regards crop growth.

We are not visionary in our ideas as to the grand ultimate result of general agriculture in the so-called dry or sub-humid belt.

This great belt of country that is so attractive to the eye of the observing traveler, and by its general appearance persuaded so many to invest in a home or for speculative purposes in its broad acres in the early 80's and upon which so many air-castles of enormous magnitude were built with glowing and bright prospects, is today the same attractive belt, with a future unsurpassed for grand possibilities. Now, I hear you say, "Why waste ink and paper in over-drawing that forsaken country again? The rainfall is not sufficient to grow crops every year; therefore, farming is too uncertain, and you can't make the country any different by all this high coloring. If you had the rainfall they have in Ohio, you might talk."

Ah, yes. Now you have hit the key to the situation, It is the fact that we do not get the average rains they have in Ohio that makes our country so exceedingly desirable. We would not have so rich and fertile a soil if we had so much water. We could not till our soil so nicely; we would not have so many bright, sunny days; we would not have that invigorating and health-giving climate, so entirely free from miasma, malaria and other climatic causes of disease; we would not have such beautiful harvest seasons; we would not have such lovely roads both spring and fall, all of which are very desirable for both man and beast. That the soil is rich in plant food is proven under almost any tillage, when rain comes in sufficient quantities and at proper intervals, thus proving that plenty of moisture at all times is all that is needed to grow mammoth crops.

Now we come to the point where the science of soil tillage comes to our assistance, and to the observing student presents a very strong and plausible argument why nature could not have done more for this great belt. She has placed a soil upon its face remarkable in its absorbing qualities for moisture, by the peculiar cell or column formation of the subsoil. This moisture is very easily controlled; by the interstices between these small columns the water is easily and quickly carried down by gravity and by the close relation of the particles of soil in these columns vertically. This same moisture is easily lifted back up these columns by capillary attraction to the roots of the plant as needed, just the same as oil is carried up the lamp-wick as it is evaporated by the heat of the blaze at its end. One of the most remarkable discoveries in soil tillage is the fact that certain conditions

of the soil, produced by simple mechanical work, will move the moisture more rapidly through the soil, while another condition, produced by a different line of mechanical work, will check the movement of moisture in the soil; in fact, almost stop its movement for a time. To know that these facts are true is of great value to the farmer; and when we are able to ascertain by some simple device just the proper quantity of moisture to retain in the soil for best possible results, we will then be able to grow the best possible crops each year.

In a recent communication from one of the best posted men in soil physics, we were informed that by the aid of that most noble servant, electricity, a mechanical device had been invented by which the percentage of moisture at any point from the surface for several feet down could be quickly and easily ascertained. If it proves successful, it will be of untold value to the farming interests in developing further scientific truths. For all that, kind reader, don't foster for a moment the idea that sience will ever develop a plan of growing crops without labor. The edict that went forth at the fall of Adam and Eve stands today: "Thou shalt live by the sweat of thy brow."

When soil is made firm by any artificial or mechanical work a greater amount of moisture is gathered there. This almost any farmer has seen from the effect of "horse foot," or wheel tracks in his grain fields. These invariably show in a dry season very remarkable growths. The stock will be coarser, the number of stools very materially increased, the heads longer and better filled, which is mainly due to the very firm condition of the soil. Do not, however, loose sight of another fact, and that is, the loose mulch that falls into these tracks, putting the firm soil under loose soil. Thus you have increased moisture by increased capillary attraction, protected by the loose, dry mulch, which holds the moisture at the roots by checking evaporation.

The effect of firmed soil may be explained in two or three ways. It may not be well understood, but it is, however, a fact, that when soil becomes the least moist close investigation demonstrates that each little particle of soil, even if ever so minute, is enveloped in a thin film or covering of water, and each of the little particles will carry a film or covering up to a given thickness, when the soil will appear quite moist. Beyond this thickness, providing the soil is not impervious, the water will pass down by gravity; that remaining about the particles is held there by capillary attraction. This capillary attraction is increased as the soil becomes closer packed, for the reason that capillary attraction is increased or diminished by the increase or decrease in the surface tension.

You can readily see that when you press soil together so that two or three particles are contained in the same space that one occupied, you have increased surface tension two or three times, be-

cause you have two or three times as many square inches of surface in a cubic inch of soil. The increase or decrease in the lifting power of loose or firm soil may be very clearly illustrated by the use of differed size glass tubes. In a bunch of thirty tubes used to illustrate this point in our lecture last winter the largest was one-tenth of an inch in diameter inside and the smallest about the size of the human hair. These tubes were six and one-half inches long. While water would rise only one quarter to three-eighths inch up the larger tubes; it would go clear to the top in the smaller ones, showing that water may be lifted by capillary attraction to the height where gravity or the weight of water equals surface tension. As shown by the tubes, the quantity or weight of water inside the tubes is diminished faster than the inside surface of the tubes, or they grow smaller; therefore, the water is raised higher in the smaller tubes, thus showing that firming soil increases capillary attraction, thus increasing moisture in firmed soil over loose soil. Therefore, we find it important to have the soil firm where the roots are. There is one important action of water in scientific irrigation after the ground is plowed; water is turned on in the fall, the soil in a saturated state becomes dissolved, and the little particles become closely settled together in the lower portion of the furrow slice; all little cavities are filled by these dissolved particles. Their action is shown by the general plan adopted in filling deep ditches dug for water mains; etc., especially where soil is of a loamy formation. It would be impossible to get all the soil back into the ditch without the application of water to dissolve and settle the particles. It is also important in scientific irrigation to keep the surface soil loose and dry by constant shallow cultivation to prevent evaporation and admit air. When this is well done the growth of the plant is almost marvelous and has always been found to make a more rapid, healthy growth than under any other plan. This being true, it gives us the key to some important facts, viz.: That roots make the most vigorous growth in firm, moist soil; that by having the lower portion of the furrow slice firm, moisture is kept in greater supply for the roots, and is also drawn more rapidly up to supply the plant during excessive hot days. for it is these critical days that may increase or decrease your crop yield many bushels. With plenty of moisture at the roots, the excessive heat means increased growth, while a slight shortage means exactly what short feed means to your cattle. One of the most important lessons learned by our scientific irrigators is the value of frequent shallow cultivation, which we will explain in a future article.

AGRICULTURAL.

IRRIGATION IN WYOMING.

The reference to irrigation in the President's message and the discussion which has followed in the public press is greatly stimulating interest in irrigation and is creating an active inquiry for irrigated farms. In fact, the indications all point to a boom in this species of property.

Free government lands, outside the semi-arid regions, are a thing of the past and railroad lands unsold are held at high prices, so that fresh and cheap lands can only be had through development by irrigation.

Such lands, while comparatively cheap now under some irrigation systems and which may be cheaply developed in some favored localities, are intrinsically the most valuable farm lands and are destined yet to command the highest prices.

The combined factors of certain crops, larger yield, better quality of products, and the higher prices for products which, on account of the limited area which can be cultivated, do now and must continue to prevail, give a substantial value to such property which is sure to be recognized.

Capital which has heretofore been unreasonably shy of irrigation is now being attracted to this substantial species of investment and many new enterprises are being organized.

In the North Platte Valley, Carbon County, Wyoming, one of the best opportunities for establishing an irrigation settlement has long lain dormant for want of capital and enterprise to develop it.

This valley for many years has been a paradise for cattlemen. The extensive free range in mountain, foothill and valley and the opportunity for the cheap production of hay makes fat cattle and fat pocketbooks for ranchmen. It lacks farmers however.

WYOMING SHEEP.

In this valley, extending from the main California line of the Union Pacific Railway south to and beyond Saratoga towards Encampment, is one of the finest bodies of land in the west for the purpose of irrigation, comprising about 150,000 acres. The soil is rich and deep and lies right, and the water is superabundant and accessible, while the extensive mines in the Grand Encampment mining district afford an ample home market at high prices for farm products.

Steps have now been taken to develop this splendid heritage and to establish a settlement thereon composed of thrifty, industrious, temperate people, entitled the Homestead Irrigation Settlement. Mr. Jas. W. Wilson, the well known agricultural journalist, 79 Dearborn street, Chicago, is at the head of it. Associated with him is Mr. John M. Kuykendall, a wealthy and influential citizen of Denver, Colo., and Judge W. L. Kuykendall and H. L. Kuykendall, extensive cattlemen in the valley. Mr. Wilson has successfully located four similar settlements prior to this one, all of which are prosperous.

The plan is a liberal one, giving perpetual water rights with no subsequent rentals and land at less than half the prices afforded under other reliable systems and at about one-fourth the average price of irrigated farms of equal merit.

SOWING ALFALFA SEED.

The first essential in the culture of alfalfa is to prepare the seed bed. The ground may be plowed either in the fall or early in the spring, the same depth as for oats or wheat. Repeated harrowings should be given the land on which the seed is to be sown, and if there are any lumps it will be well to pass a roller over it after the harrowing is done. The ground should be suffiently moist when the seed is sown to insure its germination. Where there is lack of moisture it should be irrigated before the seed is sown. The seed may be sown broadcast or in drills. It should be covered about one inch deep. The amount of seed to the acre should be from 20 to 25 pounds. Alfalfa does not do well when sown with a nurse crop; those who are most successful with it give it the full use of the ground. Where irrigation is possible the first wetting, after the young plants are started, should take place as soon as the plants are to be seen well above ground. This first watering of the young plants must be done with great care in order to prevent injury. Care must be taken to prevent washing away of the soil and consequent covering up of the young growth. It is customary in the valleys where irrigation prevails to give the crop from two to three waterings before the first cutting, the first one when the plant first appears, the second a few weeks later and the third just before cutting, i. e., long enough before to let the ground dry sufficiently for mowing and curing the hay. A difference of opinion prevails as to this last watering. Some prefer to wait until the first crop is cut and housed, and then let the water on immediately after. The field is always irrigated at least once between each cutting, and occasionally twice. Where a seed crop is desired it follows the first cutting. It is seldom the case that a profitable hay crop can be cut the same season after a seed crop, but good pastureage follows the seed crop and lasts through the season. A good crop of alfalfa will yield from $2\frac{1}{2}$ to 3 tons of hay at the first cutting, and the seed crop that follows will be from 6 to 8 bushels per acre. When no seed crop is wanted and hay only is sought the field can under favorable conditions be mowed from 5 to 6 times, and the average will be about four cuttings in a season on the Pacific coast. In Colorado and Kansas the average is about three cuttings. The yield of hay from an acre of thrifty alfalfa is from five to eight tons a season.

LOUISIANA SUGAR GROWERS PROTEST.

The Cuban concession has aroused determined opposition in Louisiana. On the ninth of January some four hundred sugar growers of the state assembled in the Grand Opera House in New Orleans and fully discussed the menace to the industry they represent.

The sentiment of the meeting was resolved into a formal protest which will be presented to Congress by a duly appointed committee.

The protest in part follows:

"Our government may feel inclined to aid Cuba. Should it determine to do so, with full sympathy for the Cubans as can actuate any other citizens, the American cane growers protest against the form that the Cubans demand that this sympathy shall take. We are willing to contribute our share to aid Cuba, but we should not be called upon to give our all. The method singles out from all Americans the victims whose substance shall enrich the canefields of Cuba.

"We protest against their demands because they will result in establishing a rate of tariff on agricultural products from Cuba for all time, and which will continue to injure us so long as the tariff shall last.

"We protest because the course suggested benefits a foreign state, numbering less than 1,500,000 people, while it destroys the greater part of the invested capital and renders almost valueless the land of the best portion ot a state of this union, Louisiana."

The protests further asserts that the present price of sugar threatens the destruction of cane growing in this State and concludes: "We trust that consideration of this protest will prevent any governmental action on the lines laid down by the Cuban delegates; we trust so in our interests, as well as in those of our fellow beet sugar producers, our vegetable and fruit growers, and our tobacco planters of the United States."

PROGRESS OF BEET SUGAR CAMPAIGN.

The Holland sugar company of Holland, Mich. began slicing beets this year October 10. Up to and including December 20 this factory had sliced 22,000 tons. The quality of the crop is better than last year, and it seems that beets are improving every year. The farmers are becoming more and more familiar with beet growing, and are getting better results. The prices have been the same as last year, and the daily output for this factory is 300 to 350 tons of sugar. The present campaign will end about the first week in January: The beets placed in silos this season turned out well. They have not been damaged by bad weather or heat. About half the pulp is taken by the beet raisers themselves for stock feeding. This they get free of charge.

The remainder is sold to outside farmers. The factory secured beets from about 3000 acres the present season. The growers are favorably impressed, and next year the yield promises to be increased about 25 per cent. So far as can be determined there will be no advance in prices.

The campaign of the Wolverine sugar factory at Benton Harbor, Mich., began this year, Oct. 28, when the first beets were sliced. Up to December 20, 12,000 tons had been taken care of. The crop is of better quality than the 1900 crop and about the same as 1899. The price per ton this year was 50 cents more than last. The daily output of the factory is 175 barrels of sugar. The sugar campaign of this factory closed January 1, after a very successful run. No silos were used and the beet pulp was sold for feeding. About 1,000 acres of beets were harvested this year with excellent prospects for an increased area next year. The prices for the 1902 crop have not yet been fixed. The industry had a slight backset here from the fact that the beets used by this factory were contracted for by the Central sugar company, whose factory was to be erected at Shelby, Ind. It was not built, so beets were shipped to Benton Harbor. Many farmers lost interest in the beets and began to neglect their crop so that the yield was not as large nor was the quality as good as it might have been. In most cases the land available for beet culture in this part of the state is well adapted to the crop and by another year the industry will be pretty well on its feet in this section of the country.

The sugar company at Lehi, Utah has just closed its 11th and most successful season. The main plant was in operation about 80 days and branch plants about 70 days each. During this run 80,000 tons of beets have been cut, averaging 15 per cent sugar. A total of 8,250,000 pounds of sugar were manufactured. Farmers are so well pleased with the results of this season's campaign that a largely increased acreage will result, particularly around Springville and Provo. Approximately $350,000 have been paid farmers for beets $10,000 for lime rock, beside salaries for 270 employees.

OUR SUGAR IMPORTS.

Sugar imports in the United States in the calendar year 1901 will exceed those of any preceeding year by about 250 million pounds and the cost will be greater than any preceeding year except 1893, when prices were unusually high. The total importations of sugar in the year just ended will, according to the Treasury Bureau of Statistics, aggregate 4,670,000,000 pounds and the cost about 115 million dollars. The highest record of sugar importations in any preceeding year was, in quantity, that of 1899, 4,399,749,078 pounds; while in value, the figures of 1893 made the highest record, $123,083,217. The estimate of the Bureau of Statistics for the calendar year 1901 is based upon the actual figures of importations from foreign countries for ten months ending with October, to which are added the actual figures of sugar shipped from Hawaii to the United States. To these are added estimates for November and December, both from foreign countries and Hawaii, and for the full year from Porto Rico, this method of obtaining the Hawaiian and Porto Rican figures being necessary by reason of the fact that commerce with those islands is no longer included in the statistics of the foreign commerce of the United States. This shows an increase of about 30 per cent in the sugar importations into the United States in the decade, the figures for 1891, being 3,679,789,854 pounds, against 4,672,000,000 in 1901, the actual increase in the decade thus being in round terms one billion pounds. The enormous quantity can perhaps be better realized when it is stated that accepting the average car load at 60,000 pounds, the sugar importations of 1901 would be sufficient to load 78,000 cars. In addition to this enormous figure of 4,670,000,000 pounds imported, the sugar production in the United States for the year is presumably about 600 million pounds, this having been about the annual average during recent years. Of this four and a half billion pounds of sugar imported into the United States in 1901, more than four billions, or fully 85 per cent, is cane sugar from the tropics. The remainder is largely beet sugar, chiefly from Germany and Austria-Hungary. In the ten months ending with October the importations of beet sugar amounted to about 550 million pounds out of a total importation of more than four billion pounds. Of the more than four billion pounds of cane sugar imported during the year, about 30 per cent comes from Cuba, about 15 per cent comes from the East Indies, and the remainder chiefly from the West Indies and Central and South American countries.

ALONG THE DITCH.

FOR A LARGER SYSTEM.

Speaking of a local controversy over the best and cheapest way to provide water for neighboring orange groves the Riverside Press makes this editorial observation pointing to a national irrigation system:

"Very few individuals can afford to install expensive plants, and run long lines of pipe to carry the water from wells in the valley to the higher mesa lands to be irrigated. And we want to go on record as saying that as a commercial proposition, it will not pay to grow oranges on water that costs much more than 15 cents per inch. Growers may be warranted in paying $3 or $4 to carry their groves through one or two dry seasons but they must have a cheaper supply to grow oranges for profit, at present prices. Redlands, Highlands, Corona and other localities are learning this lesson and going after more water and cheaper water.

HOW IRRIGATED FARMING PAYS.

That farming by irrigation pays in western Nebraska has been demonstrated time and again. The results attained by irrigation in Dawson county are no greater than in Lincoln county, the requisites for success being thoroughness of cultivation and the application of average intelligence in the farming business. The farmer referred to by the Lexington *Pioneer* is A. R. Merrit, who owns a section of land under a ditch six miles north of Lexington, and the *Pioneer* thus describes his success: He raised the present year 100 acres of winter wheat that yielded about 2,900 bushels. He has 100 acres in potatoes that give promise of yielding consideraably more than 100 bushels per acre—and potatoes are worth something over $1 per bushel. He has already sold a part of his alfalfa hay, receiving therefrom $2,000 in cash; he has several acres in onions, which promise good returns, and taken altogether the revenues he will derive from this year's crop will foot up between $16,000 and $18,000.—*Gothenberg Independent*

ONE OF THE RESULTS OF THE DROUTH.

Through the West there has been four times as much corn cut up, bound and shocked as ever before. This forage will release an immense amount of hay and thus become indirectly a substantial source of revenue to thousands of farmers.—*The Corn Belt.*

EXPANDING.

The big irrigation company in Platte county has just expanded its articles of incorporation so it can increase its stock to a million instead of a hundred thousand dollars.—*Fremont, Neb. Tribune*

IRRIGATION LOVE FEAST.

Irrigation, and irrigation by the national government, was the feature of the Commercial club executive committee meeting this afternoon. Chairman George H. Maxwell of the National Irrigation Association, addressed the committee at length, and later answered a number of questions and made a number of suggestions.

The National Irrigation association, declared Chairman Maxwell, stands squarely on the president's message and the report of the secretary of the interior, and will fight and win on these lines. It ts absolutely and unalterably opposed to state control. The opposition to irrigation by the federal government is not, he declared in the east, but in the west, and it is here that the fighting must be done. The eastern business men, senators and congressmen, are favorable to irrigation under federal control.—*Omaha World Herald*

THE GOTHENBURG CASE.

The state board of irrigation has reversed the decision handed down by Former Secretary Wilson in the case of the Farmer's and Merchant's Power company against

the Gothenburg Power & Irrigation company. Secretary Wilson at the time he was in office stopped the Gothenburg company from running water in fifteen miles of ditching which it had constructed after permission to use the Platte river water had been granted,

The request when first filed called for water for power purposes, which was to be taken from the river twelve miles above the town and returned immediately below the place. Afterwards the company extended a ditch fifteen miles to the northeast for irrigation purposes. The Farmers and Merchants company, which took water from the river thirty miles further down protested, alleging that in dry seasons this extra expenditure on the part of the Gothenburg company made the supply short. Secretary Wilson held the same opinion.

The matter has just come before the state board for settlement, with the result that Secretary Wilson is reversed. The board holds that the Gothenburg company asked for a certain amount of water and the request was granted prior to the request of the other concern. If the company does not exceed this amount, the use to which the water is put, as long as it is on the lands perscribed, cuts no figure. The Farmers and Merchants company will carry the matter to the district court and ask that the first decision be sustained.—*Omaha World Herald*,

A 30 ACRE RECORD.

Z. T. Maxwell and son, W. E. Maxwell, who own a little irrigable farm of thirty acres twelve miles from Lometa on Rough Creek in San Saba county, have this year sold $4 530 worth of onions, potatoes, cabbage. tomatoes, peas, turnips, etc., saying nothing of corn and hay sufficient for their own use and not included in above figures. There has been considerable talk of how much the Maxwell's had made this year truck farming and yesterday one of them came to market here with cabbage and the merchant whom he sold to (Mr. Horn) got him to make a statement of his crop. The above figures are those of Mr. Horn's and Mr. Maxwell's and are at patch prices of the products. The Maxwells marketed their truck at Lometa, Llano, Thompson and Goldthwaite, and sold at patch prices plus use of their team and services. On the same ten acres they raised 1800 bushels of onions they raised 1500 bushels of potatoes; that is, they raised the onions and potatoes on the same ten acres the same year. In some other places in San Saba county where they irrigated this year they made two bales of cotton per acre. No wonder the president in his message had more to say about irrigation than any other subject.

"A little farm well tilled aud a little store well filled" is the thing to coin cash. The Maxwell's postoffice address is Chapell, San Saba county, Texas.

EXPANSION AT HOME.

It has been the fashion in the East to regard the demand for national aid to irrigation as an impudent Western grab for which there could be no honest excuse. President Roosevelt's message has suddenly made the proposition respectable, and for the first time it is treated seriously.

It deserves to be, for the arid region of the West is by far the greatest field now open to the expansive energies of the American people.

The region for who e full development irrigation is necessary includes Eastern Washington and Oregon, the greater part of California, the whole of Nevada, Idaho, Montana, Wyoming, Utah, Colorado, Arizona, New Mexico and the western parts of North and South Dakota, Nebraska, Kansas, Oklahoma and Texas.

In this vast domain, covering a third of the area of the United States, there are now fewer people than live in the single state of Illinois. Yet, with irrigation, it would sup-

port a denser population than any other part of the Union.

A family can live on twenty acres of irrigated land as well as on 160 acres where the crops are dependent on the rainfall. Every State and Territory in the arid region can support more people than New York or Pennsylvania. The whole present population of the United States could be comfortably accommodated in Arizona, New Mexico and Colorado.

Moreover, practieally all the public land still open to settlement is in the arid region. We have thrown away the most splendid natural endowment that any country ever had, but we have another superb landed estate still in our hands, because, as yet, nobody has thought it worth taking. It can be made the most valuable of all. National irrigation is the key that can unlock its wealth.

But, before we turn that key, it is to be hoped that we may gain a little more common sense than we have shown in disposing of our Indian reservations.—*Chicago American*

WANT NATIONAL IRRIGATION.

Over in Hawaii they are having trouble already with the water grabbers. Following is a copy of resolutions forwarded the Government at Washington.

Whereas: The first legislature of the Territory of Hawaii, during its regular session, passed resolutions relative to land and water rights as contained in House Journal on pages 355 and 356 and as recommended in the report of the Committee on Agriculture in that session, and

Whereas: Valuable land and water rights have been bartered away during the past year to private corporatins on the various islands of this group under the guise of assisting homesteaders, and

Whereas: A private corporation has been formed for the purpose of acquiring further water rights and privileges connected therewith in the Island of Hawaii and the District of Kohala thereof, and

Whereas: The holding of water rights is practically controlling ownership in the lands tributary to the watershed that is under private control, and

Whereas: Such control is dangerous to the interests of the American small farmer and land owner, without whom the future of this territory would indeed be a disgrace to our obligation and flag, and

Whereas: We firmly believe in the storage and conservation by the national government of water for use in the irrigation of this Territory. Now therefore,

Be it resolved: That the Executive Committee of the Home Rule Republican party, in regular session assembled, strongly urge Congress and the President of the United States to take such steps as to the government lands and water areas of this Territory as will conserve them in the common interests.

Resolved that we most heartily endorse the sentiments contained in a memorial transmitted to Congress and the President by the Executive Committee, Southern California section, of the National Irrigation Association of the United States.

Resolved: That copies of this resolution be transmitted to the President, the Secretary of Agriculture, Secretary of the Interior, the Commissioner of Labor and the Territorial Delegate to Congress, and that they be urged to see these suggestions embodied in legislation at the present session of Congress.

WHAT WILL CONGRESS DO?

Prof. Elwood Mead's thoughtful consideration of "Problems of Irrigation Legistion" in the January Forum deserves wide publicity and reflection. Professor Mead is no friend of patch work plans and his attitude regarding a national system of irrigation will meet with strong popular approval: Among other things he says:

"It is more than probable that irrigation will occupy an important place in the

discussions of the present Congress, and that legislation will be enacted which will inaugurate a new era in industrial development in the West. The world wide movement toward the Pacific which has followed our recent achievments in war and commerce has awakened an interest in the vast undeveloped region which separates the humid East from that ocean, and has stimulated a desire for its settlement. Expansion abroad promises to be followed by an equally momentous expansion at home. There are other reasons why this subject is likely to receive attention from Congress. Hereafter those who seek homes on the public domain must look for them in the arid part of the United States, where cultivated crops cannot be grown by the aid of rainfall alone. The homestead of the future must be irrigated. Before the settler can plant his fields with any hope of reaping a harvest, he must provide the water supply which the clouds do not furnish; and ability to do this will be the measure of settlement. The immigrant working alone cannot accomplish this. Formerly he could do so, but not now. The land which could be watered by small,cheap ditches has all been filed upon.

The further extension of the watered area requires either the diversion of large rivers or the storage of water which now flows down from the mountains, when it cannot be used. In order to do either of these things costly dams must be built to withstand the floods which beat against them; great canals, extending for miles to the remote tablelands, will have to be excavated; and expert engineering talent must be employed to design these structures and to prepare not less important plans for the management of the commerce in water which their construction will create. The day of individual effort has passed. Success in the future requires the organization of the irrigation industry and the expenditure of public or corporate funds on a scale not heretofore possible. Before rivers like the Missouri, the Big Horn, the Green, or the Columbia can be put to use, irrigation works must be built rivaling in magnitude and cost those along the Ganges and the Nile.

This will not be done until there has been legislation by Congress. The arid states cannot do it because they have not the means. Private capital will not, because experience has shown that costly private works to reclaim public lands are not profitable. Only Congress, as the custodian of the public domain, can provide the conditions indispensable to satisfactory progress. Because of these facts agricultural settlement in the West has been for many years slow, and unless more favorable conditions are secured the reclaiming of public land will soon be practically at an end. The conquest of the desert is a great undertaking, and even with all the aid Congress can be induced to extend, progress hereafter will not be rapid.

The desire of the West, however, is not so much for rapid development as for the creation of better social and industrial conditions. The first generation of home-makers is not longing for new ditches, new settlers, or increased demands on the water supply until it is assured of relief from the evils and uncertainties incident to the haphazard development of the past.

THE OVERFLOW.

THE CLIFF-DWELLERS.

In Southwestern Colorado there lies a great plateau, thirty miles long and twelve or fifteen wide, called the Mesa Verde. It is situated largely in the Ute reservation, and contains the ruined habitations of a marvelous race of people called the Cliff-Dwellers, who lived, wrought and died thousands of years ago. They existed before the mound-builders, and many traces of their lives can be found in the southwestern part of our country—including Colorado, Utah, Arizona and New Mexico—although the principal remains are found in the Mesa Verde.

The Cliff-Dweller was a medium-sized, dark-skinned fellow, with coarse black hair, fair teeth, and a skull which was flattened at the back. He was a farmer and built his home among the arid canons of the southwest; possibly to defend himself from the attacks of more war-like tribes. High up in the most inaccessible parts of this mountainous region are the crumbling homes of this strange people. They were not the huts of savages, but exhibit a surprising architectural grace. Their castles and fortresses, now partially buried beneath the accumulated debris of centuries, were almost impregnable, and travelers of the present day have a weary climb and many difficulties to encounter before reaching them. Their buildings were of great size, one in particular being nearly three hundred feet long and two hundred feet wide. It must have contained several thousand rooms, averaging five by twelve feet, arranged in suites of nine rooms each. The walls and floor are plastered with a hard, gritty cement, and the evidence indicates that it was destroyed by fire. The small size of the rooms and their narrow and low entrances are proof that the Cliff-Dwellers were a small people; and it is interesting to note that in their various stone work, there have been found no stones of large size.

Some peculiar names have been given to these half-buried houses, such as Honeymoon Cottage, Gibraltar House, Moccasin House, Cliff Palace and Spruce Tree House. The last named is so called from the fact that a monster spruce tree has grown up through the walls, showing that ages must have gone since the seed found its home in the crevice of the ruins.

This is one of the best examples of the Cliff-Dwellers' homes. It stands far back under an over-hanging shelf of rock which affords protection on each side and contains an appreciated blessing to the tired traveler—a spring of pure, cold water.

The Cliff-Dwellers, like the Egyptians, were adepts in designing, and their hieroglyphics, or picture-writing, can be found on many of their dwellings. Some of the houses are colored in places, a dull red. And all about the various ruins are scattered relics of their skill and industry. We find bowls, jars, arrow-heads, beads shells, amulets, baskets and mats. Unfortunntely, many of these relics have been destroyed or carried away by the insatiable relic hunter, but enough remain to show that these people pessessed a fair degree of civilization.

An organization has been formed having for its object the protection and preservation of these ancient ruins. It is called the Colorado Cliff Dwelling Association, was organized in 1899, and is composed of fifty women. This organization has prepared a bill to be submitted to congress at its coming session, in which it is provided that the region in which these habitations are found shall be set apart as a national park, to be under the care and control of the government, as the Yellowstone National Park is today.

The Mesa Verde is the graveyard of lost and half forgotten tribes, who had passed out of existence before the ancient mound-builders came to the country. Their ruined castles, amid the canons of Colorado, and regions which once teemed with a busy population, are now given over to the coyote, the prairie dog and the Indian. It is a weird and silent country, whose story is almost lost in the darkness of the past.

MACHINES AND THE FARMER.

The wonders wrought by machinery in many lines of human and animal work have been best realized by bringing the story into figures. The engines of the world are reckoned in horse powers and the enormous number of horses that would be required to replace them have been computed; other machinery, such as shoemaking, have been estimated in the number of men and hours needed to do the work of a complete set of machines. The most telling presentment is what machines have done for farming. Calculations have been made of the time and cost of producing a bushel of wheat, corn, etc., in the 19th century and by the aid of implements and machines at the close.

Before the use of improved machinery the average time required to produce a bushel of corn was four hours and thirty-four minutes; by the use of machinery the time is only forty one minutes, while the cost of the labor declined from 35¾ cents to 10½ cents.

The advantages of machine over hand labor was greater in some lines than others. One of the greatest was in the shelling of corn; in this case the machine, operated by steam, shells a bushel of corn a minute. In the old way the labor of one man was required for 100 minutes to do an equal amount of work.

The amount of human labor that has now to be expended, from beginning to end, to produce a bushel of wheat occupies only ten minutes. In 1830 it was three hours and three minutes.

During this interval the cost of labor to accomplish this has declined from 17¾ cents to 3½ cents. According to these figures the pay of the laborer is increased from a fraction under 6 cents to 20 cents per hour.

The plow of 1830 was a heavy and clumsy affair, seed was sown by hand and harrowed into the ground with bush harrows. The grain was cut with sickles, hauled to a barn and threshed with flails, after which it was winnowed upon a sheet fixed on rods. The grain was thrown upon it with a shovel and tossed up by two men until fhe wind had blown the chaff away.

In the case of the corn crop the money measure of the saving in the human labor required to produce it in the last year of the century, as compared with the old methods, was $523,276,642, for wheat, $79,194,867; oats, $52,866,200; corn, $1,408,950; barley, $7,232,480; potatoes, $7,366,820; hay, $10,034,868, a total of $681,471,827.—*Farm Machinery.*

HAWAII AND PORTO RICO.

In the act making appropriations for the U. S. Department of Agriculture for the present fiscal year Congress provided for the inauguration of experiment stations in the islands of Hawaii and Porto Rico. In accordance with this provision, the Department has taken preliminary steps to determine the best plan of operation in each case and the subjects which are in most need of immediate attention. The work has been placed in charge of the Office of Experiment Stations, and the following information in relation to the action taken by that office is from Experiment Station Records, Vol. XII, No. 1.

Prof. S. A. Knapp, of Louisiana, has been selected to investigate the agricultural conditions and possibilites of Porto Rico, and went to the island in June. He will study the existing agricultural condi-

tions, the lines of experimental investigation which should be undertaken there, locations suitable for stations, and the approximate expense of inaugurating and maintaining the work. He will also look into the feasibility of undertaking co-operative experiments with the residents of Porto Rico and the best means of reaching the people through publications, demonstration experiments, and otherwise.

Dr. W. C. Stubbs, director of the Louisiana Experiment Stations, will make the preliminary survey of the conditions in the Hawaiin Islands. He sailed for Hawaii about the middle of July and spent the month of August in the island. The conditions there differ from those in Porto Rico, as a station for experiments in sugar production has been maintained by private beneficence for a number of years. The lines in which investigation is most needed, the possibility of greater diversification of agriculture, the expense of the work, and the means of disseminating information will be carefully inquired into. This will probably prove a profitable field for investigations on the use and economy of water in irrigation since, according to reliable reports, in no other place is so much money expended for pumping water for irrigation. Some pumps are said to be raising 30,000,000 gallons of water per day from a depth of 500 feet, and the expense of irrigation in some cases reaches as high as $125 per acre annually.

FOOD VALUE OF THE POTATOE.

The sientists connected with the Department of Agriculture have been making investigations with the purpose af ascertaining facts regarding the food value of the potato. These investigations have had the result of confirming the belief that the general practice of serving potatoes with meat and other foods which contain generous proportions of protein is justified on scientific grounds, as one food supplies the chemical elements lacking in the other. Potatoes and other foods which contain carbohydrates are often objected to on the grounds that they are starchy foods and do not supply a sufficient degree of nitrogenous matter.

It is well to remember, however, that a considerable amount of protein is contained in the potato, and also that carbohydrates are an indispensable part of a well-regulated diet. The experiments referred to show that potatoes when properly cooked supply such material in an easily-digestible form.

To secure the greatest food value from potatoes they should not be peeled before cooking, and should be placed directly in the hot water and boiled rapidly. When they are placed in cold water, which is gradually heated to the boiling point, a great loss of material is sustained—*Washington Times*.

EFFECTS OF MUSIC ON HORSES.

Horses are, of all animals, the most susceptible to the influence of music, we are told by M. Adolphe Guenon, who has just published a book on "The Influence of Music on Animals." "His experiments," says *The National Druggist* (December), "were conducted personally, the flute being the instrument used, and the horses experimented on were those of the regiment of cavalry to which he was attached. He states that the number found by him wholly indifferent to music was surprisingly low, not more than one in five (20 per cent.). The following excerpt from his work is most interesting:

"Those under the influence are visibly impressed, demonstrating their feelings by an attitude of attention, maintained throughout the entire performance. They swelled their chests, carried their heads higher, the ears flung forward and kept fixed in the direction of the sound. The line of the back was raised, and the tail carried as though the animal was moving instead of

standing still. Some of them kept eyes upon the instrument from which the sounds emanated, as long as it was being played, while others stood immovable in front of their racks as though lost in contemplation, the fixedness of their ears showing that the animal did not desire to lose a single note of the pleasing sounds and that his whole attention is concentrated in the organs of hearing—a fact that should be compared with that 'contemplation by hearing' spoken of by Proudhon. We might say without exaggeration that these animals are charmed. It is easy to see that they are profoundly affected, and that the music moves them. The sensation is evidently not disagreeable since they manifest neither inquietude nor impatience.' Right here is the most curious feature about the matter—the emotion that they feel, whatever it is, reacts powerfully on the bladder or intestines or both."

THE QUEER CHINESE

A Chinaman's Christian name comes after, not before, "his honored family name."

He shakes his own hands instead of his friend's.

He puts on his hat in salutation when we take it off.

He feels it unmannerly to look a superior in the face and takes off his spectacles in his presence.

He deems it polite to ask a casual caller's age and income.

His long nails are not a sign of dirtiness, but respectability.

His left hand is the place of honor.

He does not consider it clumsy, but courteous, to take both hands to offer a cup of tea.

He rides with his heels instead of his toes in the stirrups.

His visiting card is eight and sometimes thirty inches long.

He keeps out of step when walking with others.

He carries a pig instead of driving him.

His compass points south.

He carries a fan even if he is a soldier on active service, or if he is going to his execution.

His women folk are often seen in trousers accompanied by men in gowns.

He prefers a wooden rather than a feather pillow.

He often throws away the fruit of the melon and eats the seeds.

He laughs (to deceive evil spirits) on receiving bad news, and his daughters loudly lament on the eve of their weddings.

His favorite present to a parent is a coffin.

His merits often bring a title not to himself, but to his ancestors.

And with all this he is a born financier and business man, is always a worker, and many of his ideas might with profit be imitated by white people.

THE HEALTHY WAY TO BATHE.

Never use hot water. Make the bath short, cool and frequent. Determine by experiment whether you can stand cold water. If you feel invigorated it is beneficial; one may use tepid water, but never hot. One should bathe twice a day at least for mere cleanliness, says Prof. Anthony Barker in a article on Home Physical Culture for Women in the February *Delineator*. The morning bath may consist of squeezing a large sponge filled with cold water once on the upper part of the chest and once on the back of the neck while standing in a tub. Then rub vigorously with a coarse towel. After exercising another bath should be taken. However, do not neglect the exercise if you cannot take the bath. It is better to exexercise and go without bath than to bath and not exercise.

SOME RESOLUTIONS.

When the Texas farmer makes up his list of New Year's resolutions he might resolve, among other things:

To raise less Cain and more long sweetnin',

To plant an orchard.

To abandon razorbacks and mossbacks and to raise Poland-Chinas and diversify.

To have a garden.

To quit raising $5 yearlings on $50 land.

To raise a few mule colts.

To raise beef cattle or else go into the goat business.

To have a potato patch.

To have poultry that will pay and raise fewer dunghill fowls.

To spray for boll weevils.

To get rural delivery service or ask Uncle Sam the reason why.

To get out of debt.

To pay less for wear and tear of vehicles and have good roads.

To keep his resolutions.—*Dallas Farm Journal*

IS IT WORTH WHILE, AFTER ALL?

"Brain fever at twelve—and we are left alone."

"We pushed her, and God knows how we have suffered for our mistake."

"She graduated, but she never recovered, and in two years we had no daughter."

"I thought more of a diploma than I did of my child. Now, I have only the diploma."

"Everything that love and skill could suggest was done. But our eyes had been opened too late."

" 'Promotion! Promotion!' was our cry Then our little girl was promoted. But not in the way we hoped."

"We placed an education above health, and the life of a promising girl of eighteen is the price of our mistake."

"It was music and painting added to a tired brain. Now our house is still—a monument to our thoughtlessness."

"What would not my husband and I give of our means today if we could undo the past and bring our only child back! That is the hardest part to bear: the feeling of what we might have done. From the housetops would we cry out to parents to take care!"—*Nine American Parents in the Ladies Home Journal for January.*

EGYPTIAN COTTON IN THE U. S.

Anent the subject of irrigation to reclaim the arid west, which subject President Roosevelt has pointedly called to the attention of congress, a discovery has just been made which it is hoped will hasten congressional action along the line suggested. The discovery is that Egyptian cotton can be successfully grown in the desert of Arizona and to the immediate south thereof. Of course this can only be done by irrigation. But the experiment has been tried there this year with entire satisfaction. It is reported that samples have been sent the agricultural department at Washington which has pronounced the cotton as fine as the Egyptian staple. This exceptional grade of cotton has been tried in the southern states but our climate is not dry enough to produce the best results. Yet we annually send $8,000,000 to Egypt for her cotton. If the same can be raised in Arizona and New Mexico through irrigation, certainly it should be done and this $8,000,000 a year be kept at home. In this connection the *New Orleans Picayune* has the following editorial reference:

"It should be remembered that in Egypt the climate is extremely dry and rainless and all agricultural crops are grown by the aid of irrigation. In this connection it is worth mentioning that tests made at the government stations have demonstrated to the satisfaction of the department of agriculture that Egyptian cotton can be successfully, and perhaps profitably raised in the rainless and what may be called the desert region of Arizona.

According to a report from Phoenix, in that territory, officials at the government experimental farms, and land owners in that portion of the country, are very enthusiastic over the outlook for the introduction of the cotton industry.

"Last spring at the government stations near Phoenix, nearly an acre was planted in the Egyptian seed, and a planting of the same size was made on the great Chandler tract, and in the eastern and higher part of the valley. The crop has just been gathered, and from samples sent to the secretary of agriculture, a reply has been received by Director McClatchie, in charge of the experiments, that the cotton was the finest ever seen in the department, and that the yield, according to Prof. McClatchie's figures, was better than that of the average Egyptian cotton in its native soil.

"It is claimed that in many respects the valleys of southern Arizona, New Mexico and of Old Mexico are similar to the valley of the Nile. The soil is almost identical; there is little difference in climate, and irrigation is as necessrry as in Egypt."

DESTINY OF THE HOG SKIN.

The oily, greasy, thick pig skin is arousing new interest. Heretofore the slaughterhouse has not seriously bothered itself about skinning the hog while his green hide left on the carcass and unemcumbered with expense brought eight cents per pound and more as pork, or 12 cents per pound when weighed in as cured ham or smoked bacon.

The scientist will not let things alone, however, and it may yet pay to strip the hide from the hog for commercial purposes. The leather splitter has demonstrated his ability to shave hides almost into tissue leather. With this implement at his command and a new process in his possession, an American inventor claims that he can split a pig skin to the fineness of a cologne bottle stopper cover and manufacture that article at a ridiculously low price. He can make the finest of "imported" kid glove stock, can displace oiled paper with a better and cheaper article and do the same with the fine texture of rubbered goods now used for waist shields. A hog hide can be treated so finely and split into so many separate skins as to astound the uninitiated. With this prospect before it, the hog skin has a right to come off and to expect much, in the near future.—*Nashville Provisioner*

FARMER OWNERSHIP OF DITCHES.

The example of the farmers owning land under the Otero ditch in Otero county, in arranging for the purchase of the water-rights, is one worthy of consideration by agriculturists in other sections of the state. The farmers themselves have far greater interest in the irrigation ditches than even the capitalists who have heretofore been the only constructors of these benificent enterprises. Having practical knowledge of their own needs, they ought to be able to manage the business successfully.

If the farmers about Fowler and those about Eaton who have recently acquired large interest in irrigation works, make successes of the management—and there is no real reason why they should not—the idea may be extended generally and may result in the happiest solution of the many problems soon to come from the national irrigation enterprises now in full sight. Practical, and not political control of reservoirs and ditches are absolutely essential to their success and farmers themselves are the ones possessed of practical knowledge to eminent degree.

The Union Pacific and other corporations that have censtructed ditches and opened up vast sections of land by irrigation have succeeded because they have gone about it intelligently. State control has, on the contrary, been anything but a glowing success because of politics. It

may be that the farmers cannot themselves succeed in this enterprise but it is well worth the trial. The experience of the farmers about Fowler and Eaton will be watched with interest by a vast number of people throughout America.—*Colorado Weekly Times.*

SILT.

Irrigation now means fertilization. If the facts are as shown by the Arizona Experiment Station, and if the government is to irrigate the arid West then it will furnish the poor settler with a farm, fertilizers and a supply of water. As it has already aided systems of transportations with millions of money, and timber from public lands to build farmhouses and stables, there is little more to be done by the government to enrich the settlers or in aid of competition with eastern agriculture.

The Arizona station estimates that the value of the silt deposits on irrigated land of Salt River for one year, at commercial rates for fertilizers contained, is about one million dollars, and second only to the value of the water for irrigation. The potash, nitrogen and phosporic acid in the waters of irrigation, per acre, are thus calculated:

	When sampled.	Per ct. silt by volume.	Com'l value.
Colorado River..	Oct. 14-20	7.88	$ 8.54
Salt River......	Sept. 1-9	2.35	23.23
Gila River......	Sept. 8.15	19.90	35.49

As an illustration of the value of the silt, a farmer is referred to who had a surplus of water, and raised an embankment three feet high at the lower end of a piece of rough land, and in six weeks the embanked space was half full of mud, and when drained became a valuable field of fertile soil. These facts are in line with the high fertility and productivenss of the silt of the Nile.

WYOMING.

The serious character of the recent July droughts which so jeopardized the western crops gives an unusual interest to the investigations of the United States Geological Survey which are being conducted in the Big Horn Mountains of Northern Wyoming. It is in this section that the porous water-bearing rock formations come to the surface, which are known to underlie the whole of the Great Plains region to the eastward, and from which are derived the very considerable artesian water supply which means so much to the industrial and agricultural development of the section. Along the slopes of the Big Horn Mountains, the Black Hills and at other localities, numerous mountain streams flow across the upturned faces of rock layers and furnish water which slowly works its way along under the plains to the eastward. In these mountain regions it is possible to measure the thickness, study the character of the rock lying beneath them, and obtain other information of value throwing added light on the important question of the water resources of the Great Plains. The work is being conducted by Mr. N. A. Darton, who has spent several seasons in similar investigations.

THE LAST OF POOR LO.

Civilization is having its effect upon the Indian papoose as well as upon the warrior and medicine man, says the *Delineator* for February. In a few years more there will be no more little full-blood babies, so fast is the extinction of the red race being accomplished. And when the redskin children are no more, the West will note the absence of its most stoical little Americans, the most picturesque of all babies. In a well-illustrated article on the subject W. R. Draper discusses the passing of the Indians, of which the present generation of full-blood babes will be the last.

The new Factory (Windmill Department), of the Stover Mfg. Co., Freeport, Ill. Capacity, 75,000 Windmills per ann m.

LAUGH AT THESE.

BILL NYE AS A DAIRYMAN.

When I was young and used to roam around over the country and gather watermelons by the light of the moon, I used to think I could milk anybody's cow, but I don't think so, now. I do not milk the cow unless the sign is right, and it hasn't been right for a good many years. The last cow I tried to milk was a common cow born in obscurity, kind of a self-made cow. I remember her brow was low, but she wore her tail high and she was naughty, oh so naughty.

I made a commonplace remark to her. One that is used in the very best society, one that need not give offense. I said "So" and she "Soed." Then I told her to "Hist" and she "Histed. But I thought she overdid it. She put too much expression in it.

Just then I heard something crash through the window of the barn and fall with a thud, a sickening thud, on the out side.

The neighbors came in to see what it was that caused the noise. They found that I had done it in getting through the the window.

I asked the neighbors if the barn was still standing. They said it was. Then I asked them if the cow was injured much. They said she seemed quite robust.

Then I requested them to go in and calm the cow a little, and see if they could get my plug hat off her horns.

I am buying all my milk of a milkman. I select a gentle milkman, who will not kick, and feel as though I can trust him. Then, if he feels as though he can trust me it's all right —*Bill Nye*.

THE ENERGETIC HEN.

There was Once an Energetic Hen who paid Strict Attention to Duty and never was below the Average in her Daily Output of Eggs.

Each time that she Laid an Egg a Rooster would Crow lustily and excitedly and Announce the Fact to the World.

Now, there were Certain Hens that belonged to the Gossip Brigade, and they were Fill?d with Envy because of This

So they went to the Energetic Hen and said:

"We think it Just Awful the way Mr. Rooster takes all the Credit for your Success. Every day he Crows and Exults over What is Really your Achievment."

But the Energetic Hen smiled Cheerfully and Answered.

"Do not Lose any More Sleep over it, for he is my Press Agent."

Moral—If you Make a Success at Minding your Own Business, all your Friends will Assist you in Minding it.—*Baltimore American*.

ENGLISH CLUB WOMAN'S STORY

In the State Federation of Women's Clubs at this morning's session, Mrs. Hugh Reed Griffin of London was invited to address the convention. Mrs. Griffin, whose husband is an American, formed the first American women's club in London. The club has become very popular, has attracted widespread attention in England and has the effect of establishing a better understanding between English and American women.

Mrs. Griffin told about the formation of the club and its work. She stated that there was some prejudice in England against the American club woman, and that she, herself, shared that prejudice to some degree.

"The American club woman is so terribly busy that I often wonder, and so do other people wonder, if she finds any time

at all to spend at home," said Mrs. Griffin, "I heard a story once which aptly illustrates this fault in the American club woman. Three little boys were together and their childish talk finally drifted to the question of where they were born. One little boy said:

"I know where I was born. I was born at No. 38 Washington street, and I know where the house is, too." "And one of the other little boys said.

"I know where I was born, too. It was at No. 50 Pennsylvania avenue, and I can take you right to the house.

The third boy hesitated and finally said: "I don't know where I was born, but I know when I was born. I know there wasn't anybody home at the time but me and grandma, 'cause mother was at the club.—*Buffalo Commercial*

AS THE PUPILS UNDERSTOOD IT.

A teacher, says the Boston *Transcript*, had been reading to her young pupils an account of a man who had lived some years upon the frontier. When the story was reproduced by a child, to her surprise it read that he had lived for some years on his "front ear!"

Another teacher read that a gentleman had occupied for some time a fine country-seat. Upon asking the children what was meant by a 'country-seat' a dead silence reigned, until one little fellow said he thought he knew, and to the inquiry of the teacher replied "a milking-stool."

Still another teacher had been reading to her pupils about the rain. Asking one of them to write a little story about the rain he, after declaring his inability to do so, upon the teacher's insistence produced the following: "What does the rain say to the dust? "I am on to you, and your name is mud!"

Now, Harry, asked the teacher of the juvenile class, what is the meal we eat in the morning called?" "Oatmeal," was the little fellow's prompt reply.—*School Journal.*

AND EASIER HAULING.

Here is a drought story told by a traveling man;

"I was driving across the country to a little town in Western Kansas the other day when I met a farmer hauling a wagon load of water.

"Where do you get water?" said I.

"Up the road about seven miles," he replied.

"And you haul water seven miles for your family and stock?"

"Yep."

"Why in the name of sense don't you dig a well?"

"Because it's jest as far one way as the other, stranger."—*Chicago Journal*

Exact Statistics.—"I can tell you," said he, "how much water runs over Niagara Falls to a quart."

"How much?" asked she.

"Two pints."—*Chicago Journal.*

AS IT'S WROTE.

She calls herself Cathryn Mae,
And yet there are gossips who sae
  Cathetine Mary's her naym,
  Yn supporting which claym
They ynsyst she was chrystened that wae.
—*Exchange.*

JUDGE CLESSON S. KINNEY, SALT LAKE CITY.

THE IRRIGATION AGE.

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THE IRRIGATION AGE.

D. H. ANDERSON PUBLISHING CO,
PUBLISHERS.
112 DEARBORN ST., CHICAGO.

A monthly illustrated magazine recognized throughout the world as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world, and has no rival in half a continent. It advocates the mineral development and the industrial growth of the West.

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D. H. ANDERSON, - - Editor.

Judge Clesson S. Kinney, Salt Lake City. In 1896 Judge Clesson S. Kinney of Salt Lake City, prepared an article for the editor of *Wind and Water*, which was duly published in that magazine. Subsequently a portrait of Judge Kinney was secured for publication, but owing to the suspension of the publication it did not appear and we are now re publishing the article, entitled "History of Ancient Irrigation in Various Countries," and reproduce his portrait as a frontispiece. We trust that it may be possible to induce Judge Kinney to prepare an article for some future issue of THE IRRIGATION AGE on the importance of irrigation to Civilization in modern times. Judge Kinney is good authority on all matters pertaining to irrigation and anything from his pen will be highly interesting.

Cuban Sugar. No class of people are more interested in the Cuban Tariff legislation than the "irrigators." The proposed tariff reduction on the Cuban sugars means a death blow to the exceedingly thriving and very profitable beet sugar industry everywhere in the United States. The inevitable result of expansion is already shown in the admission of the sugar fields of Porto Rico and Hawaii within the protected limits, and the product of sugar cane from these points will come on the market without any tariff charge. It is well to know, as has been definitely ascertained, that the production of sugar cane from these two points is so limited and the possibilities of increasing it are so well defined, that there is no serious danger of any disturbance of the market from this source. With Cuba it is different. In five years Cuba could produce a supply of sugar for the whole of the United States. This statement seems to be exaggerated, but it is based on the report of the United States department of agriculture. There seems to be no limit to the possibilities of increasing the cane sugar product from Cuba, once the tariff wall is lowered.

The beet sugar industry of the United States is yet in its infancy and without protection will be at the mercy of the

sugar refining trust, which will resort to obvious and devious methods to crush this threatening competition and insure and increase its home monopoly on this established product.

The possibilities of the product of beet sugar in the United States are only yet in their beginning. Germany produces not only beet sugar to supply its own inhabitants, but to send to the United States some million pounds annually. With the extension of the irrigation idea under favorably climatic conditions, there is no reason why the beet sugar industry in the United States should not attain proportions which will enable it to at least in time supply the home demand. The only threatening danger is adverse legislation, and those who are interested in the beet sugar industry and development in irrigated areas and areas capable of irrigation, should use their utmost influence to prevent the wrecking of this great and growing business for the furtherance of the interest of the sugar refining trust or in response to a sentiment for the Cubans.

In regard to this question of sentiment; if it is the duty of the United States to aid the Cubans in establishing their industries, it certainly is also the duty of this country to do this without striking a blow at so promising an industry as the beet sugar business.

Department of Agriculture. No department of our national government confers greater benefit on the whole people than the department af agriculture. Moreover it is a department of practical purposes whose blessings are immediate, generous and visible. The difficulty and variety of its problems are equal to those of other departmonts, and the presentation of their wise solution demands as much skill, discrimination and courageous decision as an ultimatum of the war department, or a restraining order by the pos master general.

The publication division of the department of agriculture owes its popularity and strong influence largely to the untiring genius of George Wm. Hill, editor and chief, whose intelligent service to the American farmer is measured by the improved methods, increased products and growing importance af agriculture, as the basis and source of American progress and supremacy.

Long and familiar experience with every branch and detail of his chosen science has eminently qualified Mr. Hill for the exacting responsibilities of his high office, and in no single instance has his broad, sound judgment been more clearly demonstrated than in his desire to promote popular education in the art of irrigation, and the logical subsequent creation of a great national system which shall be scientific, adequate, permanent.

We therefore again refer with much satisfaction to the interesting series of papers on "Irrigation in Field and Garden," prepared by Prof. Wickson, now appearing in THE IRRIGATION AGE, by courtesy of Mr. Hill's department.

In these papers every mystery of irrigation is solved by direct and simple explanation and the way prepared for more advanced study of the subject.

Their appreciation by our readers in every section, and abroad, is attested by an increasing volume of correspondence and a thriving circulation.

Unexpected Support. The *Grape Belt*, published at Dunkirk, N. Y., is a warm supporter of irrigation industry and takes sides as against its local supporters in the New York fruit section as will be seen from the following clippings, the first being a copy of resolutions passed by the New York State Fruit Grower's Association at a meeting held in Syracuse late in 1901.

Mr. S. S. Crissey, Horticultural editor of *The Grape Belt* asks what we think of the stuff contained in this set of resolutions. His own reply printed below covers our position exactly. The friends of irrigation are fortunate in having for champions *The Grape Belt* and its forceful horticultural editor, Mr. Crissey.

The following is a copy of resolutions

of The New York State Fruit Grower's Association:

"WHEREAS, The one great burden on the husbandry of the United States consists in the perpetuation of the superanuated policy of the government in giving its arable lands to anybody and everybody who will occupy them, thereby constantly maintaining and increasing a most unfair competition with farmers and orchardists already established, and diverting to the far West thousands of men who would naturally furnish the much needed force of labor for farmers and orchardists who have bought their lands and paid or agreed to pay for them; and

WHEREAS, This injury would be continued for many generations longer, should any project be adopted for bringing into a cultivated state the immense tracts of the public domain now arid; therefore be it

Resolved, That the New York State Fruit Grower's Association in the name of every fruit Grower in the country who has not received his land as a gratuity from the National Government, denounce all projects for irrigating any portion of the public domain at the public expense, every such project being a direct blow at the prosperity of American husbandry at large; and therefore at the best interests of the whole American people, broadly viewed.

Resolved, That an authenticated copy of these resolutions be forwarded by registered mail to the President of the United States with the request that he withhold executive approval from any bill intended to pave the way for government irrigation, should the advocates of such a measure succeed in securing its passage by the both houses of Congress.

Resolved. That an authenticated copy of these resolutions be sent under seal and letter postage to every member of Congress from New York, including the two senators.

Resolved, That a copy of these resolutions be mailed to the President of the Eastern New York Horticultural Society and the President of the Western New York Horticultural Society, with the request that he endeavor to secure the active co-operation of his society with the fruit growers in opposing energetically every scheme in Congress of the character referred to.

The editor of the *Grape Belt* thus refers to the action of the Syrrcuse convention: "Anti-irrigation resolutions adopted at the Syracuse meeting are received with a polite request to publish and endorse. We most respectfully decline.

"In the first place we don't know half as much about this great national question as we would like to. Give us facts and we will print them; facts first, resolutions afterwards.

"In the second place we gravely doubt whether the movers themselves of said resolutions have mastered their subject.

" 'The economic character of ten commonwealths," says Prof Wm. E. Smythe, "is dominated by the arid land question." We don't believe one in ten of the Syracuse meeting can even name these ten states.

"Thirdly, the irrigation question has far more advanced students in the old world than in the new.

"Look at the stupendous work being carried forward by the English government in building a fifty-million dollar dam to throw back for two hundred miles the waters of the Nile. West of the 100th meridian and bounded by the Pacific ocean, land to make an empire, now worthless, can be made valuable.

"Shall this land, now the property of all the people, forever remain untouched or shall the enterprise and civilizing agencies of the republic rise to the situation?

"Not hasty resolutions but careful s udy is the demand of the hour, and again makes this splendid plea for a national system of irrigation.

of the Nile above Cairo by scientists and explorers, the conclusion has been reached by many that the six cataracts from Ossouan to near Khartoum, in the river Nile, were not, as has been supposed for ages, the work of nature, but of ancient and scientific engineering for the purpose of both irrigation and navigation, engineering at once bold in its conception and colossal in its execution. That it had also been most successful in its results was evinent from the remains of irrigation canals still stretching over many degrees of longitude on both sides of the river, as well as by the ancient records of flourishing cities located where now only barren wastes are found inhabited by roving tribes of Arabs. These canals and these ruins are by no means confined to the valley of the Nile proper, but they reach to the very confines of the great desert. Gordon speaks of them as pervading the whole Soudan, as well as what is now desert on the northern side of the Nile; from the Mediterranean to the latitude fifteen degrees north, if not further, aud many degrees of longitude west as well as east of the Nile proper. Scientists were led to this belief that the cataracts were not the works of nature, from the fact that they were nearly equidistant from each other along the course of the river. The total distance from the first cataract at Assouan to Khartoum is 720 miles. The division of this space by six—the number of cataracts—will give 120 miles between each, which is the almost exact distance between the two cataracts. Also the fall of the river, being eight inches to the mile, would give a needed height to each dam of 80 feet. Exactly, in short, the calculation which would now be made by any irrigation engineer. Last, but not least, the great square granite blocks, stretching out for over 2,000 yards across the river, are still visible at low Nile. These blocks are composed of a formation that can not be found at any part of the Nile except at the cataracts or rapids. From these facts modern scientists and engineers have come to the conclusion that the cataracts or rapids were not the works of nature, but were enormous dams constructed by man, and for the purposes above described. But the proof of the dams having existed where the cataracts or rapids now are does not rest simply on the inference of experts upon the appearance of the river and its cataracts. Qhite recently there have been found ancient writings that speak of this fact. And among the various inscriptions fouud is one at Sikilis to the effect that the Nile watered vast regions above Semnah, but that the rock gave way, and that ever after the river ceased to water the region above. Truly the land of the Pharaohs was watered by the artificial application of water.

It is not our intention in this article to go into the history in detail of the art of irrigation, in all the various ancient countries of the world, and only so far as it is necessary to show that the art was

known ages before the Christian era, and was practiced in those hot, arid countries upon a colossal scale. Plato in his writings speaks of the early irrigation of Greece and Egypt. And from his writings it can be readily seen that both of these ancient nations constructed underground conduits for the purpose of bringing water from the hights and allowing it to gush forth at suitable points, both for irrigation and domestic uses; that they built immense dams, canals, reservoirs and aqueducts for the same purpose. And, whether the story of Plato of the lost Atlantis and its people is true or not, we are sure that long prior to the time that Plato wrote, these stupendous feats had been accomplished and were not then considered beyond the possibility of human engineering and skill.

I will briefly mention a few of the other early nations which were acquainted with the results of the application of water by artificial means for the purposes of irrigating lands. To Egypt, as has been seen, is attributed the first knowledge and practice of the art of irrigation; and it is claimed by some authorities that the annual overflow of the river Nile gave the first inspiration and taught the value of irrigation to that people. If this is true, it is more than probable that Egypt, in her turn, taught the art to the people of Assyria, Babylonia, Carthage, to the Phœnicians and to the early inhabitants of Italy. At any rate, at a later day than when we know the art was practiced in Egypt, we find records of these nations having knowledge of and practicing irrigation very extensively. A great many of the ancient writers of these countries speak of the canals and aqueducts. Cato, among the Romans, speaks of the formation and management of watered gardens. The Lombard kings, at a still later date, undoubtedly followed the Roman practice and encouraged and extended the art in Italy. From Lombardy the art extended to France; and the Moors encouraged it in Spain, Sicity and Algeria. The early history of Persia and China also shows that these nations were acquainted with the art at a very early date. In India the art was also practiced in very early days, and continues to be practioed to the present day; and the mighty canals and aqueducts of that country are among the wonders of the world. In fact, in all of those hot, dry and arid countries of the old world, irrigation has been practiced from almost the earliest periods, and we find that today it is in operation, but in some cases not so extensively as it was practiced by the ancient inhabitants of the country.

In fact, those who believe in the literal construction of the Bible must believe that irrigation was a God-sent act to the inhabitants of the Garden of Eden; for in the second chapter of Genesis and tenth verse we find the following: "And a river went out of Eden to water

the garden, and from thence it was parted and became into four heads."

But let us now turn from the ancient history of the art in the old world to that in the new, and see if we can find any traces of there having existed a civilization so high that the art was practiced in the ages long ago.

In South America, the artificial watering of the earth to increase its fruitfulness is of so remote an origin that its history is quite unknown. At a period probably antedating the Christian era, the inhabitants of that country understood a scientific system of using the waters of natural streams and lakes for the purpose of irrigating their crops. But the art of irrigation was lost in South America, if we are to judge by a comparison of the irrigation works of today in that country, with those of the past ages. Philologists and archæologists claim that no conceivable simple case of deterioration of an ancient race could have taken place that would have affected such a change. They think that the original inhabitants are totally extinct; and that the present inhabitants are in no sense descendants of the former occupants of the land, but rather that they represent a later migration, probably from an entirely different country. The study of the works of irrigation would confirm this theory. It seems impossible that the inhabitants of Peru and Bolivia, practicing irrigation as they do today, in the crudest conceivable manner, could have sprung from a race that at one time were masters of the art. Probably the first inhabitants came from the old world, and had lived sufficiently long in an irrigated country to be perfectly familiar with the art. For certain we are that aqueducts, canals and reservoirs were constructed on an immense scale and in such an enduring manner that they have defied the changes of unnumbered centuries. When they were built is not known; by whom they were built can not be definitely ascertained. But certain we are that there remains proof that the people who planned and maintained them were in many ways highly civilized. Some of the aqueducts were of great length One which traversed the district of Condesuyos measured nearly five hundred miles. The water was brought from some lake or natural reservoir in the heart of the mountains; and also additional supplies were obtained at intervals from other basins that lay on its route. Prescott remarks: "Canals and aqueducts were seen crossing the lowlands in all directions, and spreading over the country like a vast network, diffusing fertility and beauty around them." Most of the work of the Incas has been allowed to go to decay by the later Spanish conquerors of that country. In some spots the waters are still left to flow in their silent channels, whose windings and sources have been alike unexplored. Others, though partially dilapidated and closed with rubbish, still betray their course

by occasional patches of fertility. Such are the remains of the valley of Narca, a fruitful spot, that lies between long tracts of deserts where the ancient water courses of the Incas measure two or three feet in depth by three feet in width, and are formed of long blocks of granite uncemented, and conducted from an unknown distance. Thus this art in that country, like all of the ancient civilization of the Incas, has been allowed to fall to decay and disuse.

I cannot leave this subject of prehistoric races until I have described the works of the Tahua nations, and especially those tribes known as the Aztecs and Toltecs, who formerly lived in Central America, Mexico, New Mexico and Arizona. We are told in history that when Cortes visited Mexico, that for the purpose of irrigating the fields, the water of rivers and of mountain streams was utilized by means of canals, dams and ditches. We are also told that the network of canals by which the plantations were watered offered to Cortes' army very serious obstructions.

Probably the greatest souvenir left by the ancient races of North America is to be found in the immense network of prehistoric canals, that is found in the Salt and Gila valleys of Arizona. The age of these canals is entirely unknown and is only a matter of conjecture. That they were constructed by a race of people who had attained to a far higher degree of civilization than the present aborigines who inhabit that part of the country goes without saying. There is but one tradition among the present Indian tribes concerning these canals, and that is concerning their destruction. When Coronado, in 1542, was seeking the seven cities of Cibola, he found several tribes of aborigines in what is now Arizona, supporting themselves wholly or in part by tilling the soil. These tribes themselves occupied but a limited area. But widely scattered groups of ruins prove that in the earlier centuries all of the principal valleys were inhabited by a numerous people, who had lived chiefly by agriculture. And today in many districts their irrigating canals are still to be seen. Coronado was astonished at the extent and size of these canals, but failed to learn aught of their age or builders, except a tradition of the hasty flight of that prehistoric people and the destruction of their works.

Whether the history which has been handed down to us by the Spaniards under Coronado, and whether the tradition which the aborigines themselves tell us of as to the history of the canals, is true or not, or whether the tradition is a creation of a later day, it is hard to say. But oftentimes what is considered to be mythology and tradition in one age is proven in later ages to be facts. There is one thing sure. The tradition of the natives is corroborated to a great extent by evidence that still exists. And in the first place the ruins of these canals are plainly visible in the Gila and Salt River valleys. And ev-

erywhere are to be found the traces of ancient civilization to a very high degree, and evidences of hasty flight as well as the ravages of fire; the salient features of every pillage.

In Arizona are to be found traces of prehistoric canals, which with their laterals must exceed a thousand miles in length; and the ruins of many of them give evidence of the expenditure of vast labor in their construction. One of the largest of these canals took the water from the south side of the Salt River, about twenty-five miles from the present city of Phœnix, and after leaving the river runs for several miles through a formation of hard volcanic rocks. Thus without explosives of any kind, and with the simple tools of the stone age, the aboriginal constructors of the ditch excavated a canal through solid rock of the hardest formation, to a depth varying from twenty to thirty feet, and to a width of about twenty feet; and with the ordinary amount of water in the river, having a capacity of from ten thousand to fifteen thousand miners' inches. The evidence of the vast amount of labor for its construction by the chipping process, which gradually wore away the rock through which the canal passes, is very plain upon the face of the rock itself; while also for miles on both sides of the canal can be found enormous numbers of wornout stone hammers and axes. Convinced by the ruins of the ditch of the possibility of irrigating the surrounding country, within the last few years the work of cleaning out the debris and timber from the ditch that centuries of neglect had caused to accumulate, was commenced by a party of settlers. And so successfully was this work carried forward that at present, through the presence of the ruined canal, a population of twenty thousand inhabit a tract of land that, previous to its restoration, was but a barren waste covered by sagebrush, greasewood and cacti. The canal is at present known as the Mesa Canal, and supplies Mesa and vicinity with water for irrigation and other purposes. Two miles east of the above mentioned canal, but on the other side of the river, is the head of the Arizona Canal. This is the largest in the southwest, if not on the Pacific coast, carrying as it does nearly fifteen thousand inches of water. The construction of this canal was also suggested by the remains of a prehistoric canal that could be traced for many miles, and the promoter of the new enterprise, in the firm belief that what had been done could be done again under like conditions, had the pleasure of seeing a canal completed which reclaimed over one hundred thousand acres in and around the city of Phœnix. Forty miles west of the Arizona Canal, and a few miles below the junction of the Salt River with the Gila, and on the north bank of the latter river, is the head of another prehistoric ditch, which from the traces found along its banks, is of even more interest. It is called the "Acequa of the Painted Rocks," and commences where it can take from the Gila not enly

the waters of that stream, but also the water from all the canals lying north and east of it as well. Portions of the canal have been reclained, but those parts which the hand of modern civilization has not touched are still so distinct that their remains may be traced without difficulty for fifty miles; while between it and the Gila River, in the lauds which were formerly irrigated from it, can be found the relics of ancient civilization in profusion. These are not only in the shape of ruined buildings, but also of pottery, stone implements, weapons and ornaments. But another curious feature of this canal, and the strongest evidence of the great period of time which has elapsed since that system of irrigation was maintained, is that a few miles below the point where it crosses the Hassayamba creek, it traverses a mesa or bench for several miles, from which it falls abruptly into a valley some forty or fifty feet below. Where this fall takes place the waters of the canal have cut away for several feet the walls of the mesa, which are of the hardest volcanic character. Now, then, as every evidence indicates that the wearing away of the rock at this place has been accomplished by the action of water, centuries must have been required for the work. Upon the face of the rock thus cut away are to be found hieroglyphics of every description, and of the meaning of which the present aborigines know nothing. On account of these the white man has given them the name of "Painted Rocks."

The instances here cited of the use of natural streams and lakes for the purpose of irrigation by the ancients are but a few of the most prominent of those of the old and new worlds. Many of these ancient canals have been utilized for modern husbandry. But the very convenience by which they have been utilized has been the means of obliterating the opportunities of tracing back their history and that of the people who constructed them. Once an old ditch is repaired or restored it ceases, from an antiquarian standpoint, to be of interest, and soon its prehistoric origin is forgotten. The question often arises, how great was the skill and ingenuity that these prehistoric nations possessed in their day? The answer is, That never has the skill of the best modern engineer been able to improve on the lines of the ruined canals which were left behind them, while in the selection of locations at which to take the water from the rivers, the prehistoric races have always exhibited the greatest skill and intelligence. It was these ruins left in Arizona that, early in the seventies, first gave the settlers of the territory the idea of reclaiming the valleys where now are towns and cities surrounded by a large population of agriculturists. The first canal simply followed the line of the prehistoric one. How extensive the system of irrigation in the Salt River was may be inferred from the fact that the amount of land practically covered by the canals was over a quarter of a million of acres. The population

supported must have been very great. And it is estimated from the amount of ground that was cultivated, and the ruins of houses and the remains of pottery, shell ornaments and stone implements, found everywhere over the lands, that the population supported by the ditches would not fall short of 500,000 souls; an estimate that the best authorities consider conservative.

THE COLORADO WAY.

There can be no doubt about the genius or the advantages of Colorado now that the voice of a woman comes crying from the wilderness. In an exultant key she sings:

"As I read of sister states
Whose crops are all burnt up,
I'll just set forth in doggerel rhyme
That Colo. is in luck.

Of all the schemes that's laid by man
We like the Irrigation Plan,—
If the amount of water is to great
You shut it off with the headgate.

If the amount is quite too small
Open the gate and take it all.
And if no man comes round that way
We think your case is all O. K.

Our soil is very rich and deep
And holds the moisture many a week.
But, if perchance it fails to rain
We turn the water on again."

Bravo! Colorado. We await with breathless interest the forth coming volume sure to follow this maiden effort.

"The man who whispers down a well
About the goods he has to sell,
Won't reap the golden, gleaming dollars,
Like one who climbs a tree and hollers."

IRRIGATION IN FIELD AND GARDEN.

By Professor E. J. Wickson.

(Reprinted from Farmers' Bullettin No. 138, issued by U. S. Dept. of Agriculture.)

MEASUREMENTS OF SMALL STREAMS.

Before discussing sources of supply it is important to cite a method by which the quantity of water available in a small brook, outflow from a large spring, or discharge from a drainage system may be easily ascertained. Without an estimate of the supply, reservoir building or the determination of the area which can be irrigated is merely guesswork. Recourse to the miner's method of measurement is best for such sources as will frequently be drawn upon for the farm supply. It consists in causing the water to flow through an opening, the capacity of which is known, and which is readily capable of adjustment to the flow in any case.

A simple form of this device and its use is shown in fig. 2. The illustration represents a board 1 inch thick, 12 inches wide, and about 8 feet long. The opening is 1 inch wide and 50 inches long, and the distance from the top of the board to the top of the opening is exactly 4 inches on the upstream side. On the downstream side the opening is beveled so that the hole presents sharp edges to the stream. A sliding board is hung upon the top of the first board with a strip screwed along its upper edge, this sliding board being wide enough to cover the opening on the upstream side. In the slot there is a closely fitting block made to slide on the beveled edges, and fastened by a screw to the sliding board. It is obvious then, that when the sliding board is moved backward or forward, by means of its end, which is extended for a handle, the block moves in the slot and determines the length of the opening.

In operation the board is placed in the stream as shown in the figure, so as to dam the flow completely, and the sliding board is moved backward or forward until the water is all passing through the slot, the water being kept up to the top of the board, or 4 inches above the top of the opening. The length of the opening measures the number of miner's inches of water flowing through. If the flow is too great to pass through the opening 1 inch wide the opening may be made wider, the water still to be kept 4 inches above the top of the opening. The laws of several States provide that in devices for measuring water for sale by the miner's inch the opening shall be 6 inches high, and shall be provided with a slide as shown in fig. 2. The number of miner's inches then discharged is equal to the number

of square inches in the opening. The assumption made that the discharge is proportional to the size of the opening is not true, but the error in measuring small quantities is not great enough to be taken into consideration. By converting the results of measurements in miner's inches to gallons, cubic feet, or some other familiar unit, it

FIG. 2.—Measurement of a brook by the miner's inch method.

may be determined how long it will take the stream to fill a reservoir or cover a given field with the necessary depth of water. This unit is readily convertible into cubic feet or gallons or acre inches of water, according to the time the water flows.

The following data will be helpful in computations: One miner's inch, as described above equals 0.1496 gallon per second; 8.976 gallons per minute; 538.56 gallons per hour; 12,925.44 gallons per day; 0.02 cubic foot per second; 1.2 cubic feet per minute; 72 cubic feet per hour. One acre inch of water (that is; 1 inch in depth over an acre of surface) equals 27,152 gallons, or 3,630 cubic feet, and 1 miner's inch will supply this quantity in about 50.4 hours. Thus a simple calculation shows that a little stream of 5 miners inches will supply enough water to cover an acre 2.3 inches deep in about 23 hours—a fair amount for one irrigation of soil of average character if it has not been allowed to become too dry before the application;[1] in fact, this is an average amount actually used for an irrigation of shallow-rooted plants like most field and garden crops.

SOURCES OF WATER SUPPLY AND THEIR USE.

The sources of water supply and methods of use most frequently available for a single farm include the following: Diversion of perennial streams; development in dry stream beds; development of springs

[1]For the water capacity of different soils see U. S. Dept. Agr., Farmers' Bul. 46, p. 14.

catchment from outcroppings of water-bearing strata; tunneling to intercept such strata when deeply covered; flowing wells; pumping from wells, lakes, or streams, and storage of storm water from surface flow or from drainage systems.

DIVERSION FROM STREAMS.

Diversion from perennial streams is the most common method of securing irrigation water, and it is available for either great or small undertakings wherever unappropriated water flows in sufficient amount. In the regions where irrigation is most widely practiced there may no longer be such supplies available, but in the newer parts of the arid region and quite widely in the humid regions, farms are so situated that stream water can be readily secured.

After assuring himself in the manner described that a nearby stream carries sufficient water for his purpose, the next step for the

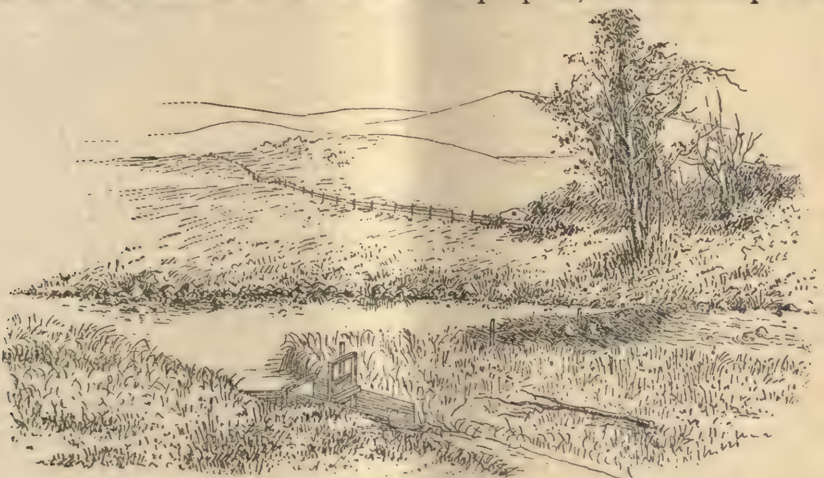


FIG. 3.—Diverting a small stream, showing brush dam and headgate.

farmer is to determine whether the water can be brought to his land at a reasonable expense. This will depend principally upon the length of the ditch which must be constructed. The simplest way to find out how long the ditch must be is to run a line having the necessary grade from the highest point of the land to be irrigated upstream till it strikes the stream. The grade on which the ditch should be built, and consequently npon which this preliminary line should be run, will depend upon the quantity of water to be carried and the nature of the soil over which the ditch will run. In general, the larger the ditch and the lighter the soil the smaller the fall which can be given to the ditch; and the shorter the ditch the smaller the fall. However, the grade should not be too light, for the ditch may have to be made larger to carry the desired supply of water. On the other hand, the grade can not be very heavy or the strong current will wear away the

ditch banks. Therefore the range of the grades which may be given to a ditch is limited. In ordinary soils a grade of 2 inches in 100 feet may be given to small ditches, and in clay soils as much as 3 to 5 inches in 100 feet may be given.

Should the line run in this way be too long, the stream below the point where the line strikes it should be examined to see if there is any place where the water can be raised by a dam high enough to flow into the proposed ditch. In case no such place is found, a water supply

FIG. 4.—Diversion of a small stream into a reservoir.

from that source must be abandoned. If this preliminary line shows that the water can be brought to the land by a reasonable expenditure of labor and money, the ditch line should be carefully located as before described (p 18, vol. 1).

It may be that the place where the line strikes the stream is not a convenient place for diverting water. In such a case the head of the ditch may be movéd upstream, and a drop put in to avoid too heavy grades, or the head may be moved downstream and the water raised to the ditch by a dam.

BUILDING THE DITCH.

Having decided upon the point of diversion and located the ditch line, the farmer is ready to build the ditch. Experience in making drain ditches will help in this. But there is this difference: Drain ditches must be kept in the ground as deep as practicable, while irrigation ditches must be kept as near the surface as may be, in order that the water can be easily taken out. The line of the ditch should first be marked by a furrow. To do this, let one man guide the team, walking between the heads of the horses, holding a bit in each hand, while another holds the plow. If the surface of the ground is such as to permit a wagon to pass along the line, the plow may be attached to the rear axle, the driver directing the team from the seat of the wagon. The furrow should be turned to the lower side of the ditch. If the surface of the ground is comparitively level across the line of the

ditch, it is not necessary to follow the stakes closely in the bends. The ditch will be better for being straightened a little, which may be done by going above the stakes that locate the bends nearest the stream and below the stakes farthest away. If the ground slopes very much across the ditch line the stakes must be followed closely. After the line is marked, two or three furrows are plowed, all being turned to the lower side. A farm ditch can be made almost wholly with an ordinary plow by going over the line a number of times. The loose earth in the bottom of the ditch may be removed with a scraper or shovels.

A small stream can be easily diverted into a ditch, if it is running in a shallow bed, by a cross-stream dam of posts and plank, of posts and brush, of brush and rock or cobbles, etc. (fig. 3). Such structures are not usually water-tight, but they will raise the water to the level

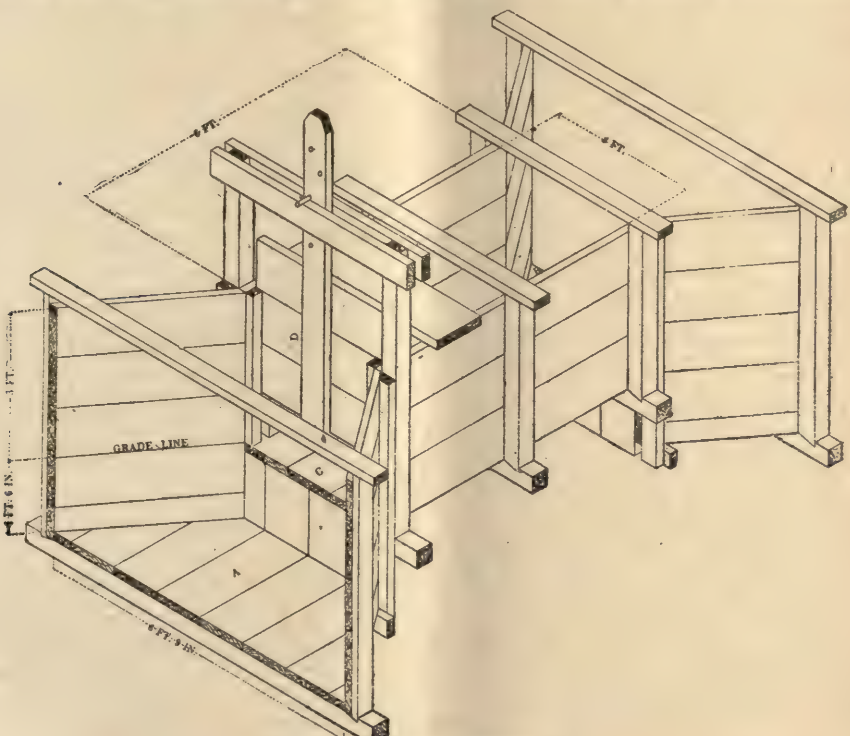


FIG. 5.—Details of a headgate.

of outflow into the ditch which is to carry it to the land to be irrigated or to the reservoir (fig. 4) from which it is to be distributed. A better dam, either of masonry or of earth, made water-tight by a puddle bar of clay, may last for a long time in a small stream if adequate arrangements are made for the passage of waste and flood water.

Raising a small stream in a deep bed requires a dam of greater

strength. In such cases it is safer to make the dam of timber or masonry arching upstream, bedded well into the banks, and puddled well above with clay, to prevent leakage, which would soon undermine and carry down an otherwise good structure. Such a dam will cause the bed of the stream above it to fill with sediment, which will reduce the direct pressure. The beginner, however, will do well to err on the safe side, if at all, and make his dam twice as strong as might seem on first thought to be necessary.

In a wider stream in a shallow bed enough water can often be diverted by a wing dam, starting just below the head of the ditch and running obliquely up the stream toward its center. Such a dam can be easily constructed of posts and brush, or of any coarse heavy material which is ready at hand or most cheaply secured. It raises part of the water sufficiently for outflow into a ditch aud is not enough of an obstruction to be torn out in high water, or, if the dam is partly destroyed, it can be cheaply replaced.

At the point of diversion from the stream a head gate should be put in. This is a very simple construction of plank with a sliding gate capable of being raised and lowered. It will protect the ditch by keeping the water out in time of high water. It should have a cross plank on the stream end, so that the water shall fall over the plank, as this will prevent much heavy sediment from entering the ditch. Obviously the dam must raise the water sufficiently to surmount this obstruction. The accompanying drawing and description of a small head gate are taken from the Yearbook of the United States Department of Agriculture for 1900.

Fig. 5 shows a common type of small headgates. It consists of a box or flume 6 feet long, 3 feet wide, and 3 feet deep, with a gate (D) at the end nearest the creek. At both ends the sides flare at an angle of about 30 degrees. Under them 1½ feet below the floor of the structure (C) platforms (A and B) are built. Both of these platforms are covered with earth to the level of the floor (C). Earth is also carefully tamped around the outside of the headgate.

All precautions should be taken to prevent water from working along the outside of the headgate. The structure may be undermined in a short time if only a small stream finds its way between the planks and the earth. The flaring wings and submerged platform are built to prevent this action and also to make the structure secure in case of high water.

(To be continued.)

THE OLD OAKEN BUCKET—A HYGIENIC VIEW.

In the *Engineering News* Dr. J. C. Bayles gives some excellent advice in the form of a parody on The Old Oaken Bucket which contains as much wisdom as wit.

With what anguish of mind I remember my childhood,
  Recalled in the light of a knowledge since gained,
The malarious farm, the wet fungus-grown wildwood,
  The chills then contracted that since have remained;
The scum-covered duck-pond, the pig-sty close by it,
  The ditch where the sour-smelling house drainage fell,
The damp, shaded dwelling, the foul barnyard nigh it—
  But worse than all else was that terrible well,
And the old oaken bucket, the mold-crusted bucket,
  The moss covered bucket that hung in the well.

Just think of it! Moss on the vessel that lifted
  The water I drank in the days called to mind;
Ere I knew what professors and scientists gifted
  In the waters of wells by analysis find;
The rotting wood fibre, the oxid of iron,
  The algæ, the frog of unusual size,
The water, impure as the verses of Byron,
  Are things I remember with tears in my eyes.

And to tell the sad truth—tho I shudder to think it—
  I considered that water uncommonly dear,
And often at noon when I went there to drink it,
  I enjoyed it as much as I now enjoy beer.
How ardent I seized it with hands that were grimy,
  And qiuck to the mud covered bottom it fell,
Then reeking with nitrates and nitrites and slimy
  With matter organic it rose from the well.

Oh, had I but realized in time to avoid them—
  The dangers that lurked in that pestilent draft—
I'd have tested for organic germs and destroyed them—
  With potassic permanganate ere I had quaffed.
Or perchance I'd have boiled it, and afterward strained it
  Through filters of charcoal and gravel combined;
Or, after distilling, condensed and regained it
  In potable form, with its filth left behind.

How little I knew of the enteric fever
  Which lurked in the water I ventured to drink,
But since I've become a devoted believer
  In the teachings of science, I shudder to think.
And now far removed from the scenes I'm describing,
  The story of warning to others I tell,
As memory reverts to my youthful imbibing
  And I gag at the thought of that horrible well,
And the old oaken bucket, the fungus-grown bucket—
  In fact the slop bucket—that hung in the well.

As Dr. Bayles was formerly president of the New York City health board he may be taken seriously when he sings:

RESERVOIRS, AND HOW TO BUILD AND MAINTAIN THEM.

BY JOHN M. IRWIN, Freeport, Ill.

Irrigation by Wind Mills and Pumps involves the selection of a good mill and a suitable pump or pumps which supplies the necessary machinery, but the Irrigator must, in addition to this, build a suitable reservoir to store the water for the reason that the direct flow of water from the pump can not be used in successful irrigation for two reasons, the first of which is the absence of pressure required to push the water forward over the land; and, second, the cold water drawn from the well is unsuited to plant life.

To make a reservoir, first select a suitable location, one that will occupy the land as high, or higher, in elevation than any of the land you wish to irrigate; then lay off the lines marking its dimensions. If the land on which the reservoir is to be built be of fresh sod, it will be necessary to plow up or remove all of the sod from the ground on which the embankments are to be constructed, otherwise there would always remain a seam through which the water would escape from the reservoir, as sod is not fit material to use in the construction of embankments, it should not be used when building them up to their required heights. When the outlines of the embankments are established and the sod removed, as before stated, then plow within the lines of the proposed embankments and with a scraper draw the earth from the inside of the reservoir to build up the walls with. The walls should not be less than 5 feet in height, measuring on the outside, and very wide or thick at the ground level. The wall should be so carried up that the slope from the inside will be very gradual, not abrupt, for the reason that if the walls are nearly perpendicular. waves of the water will destroy them, hence the advantage of making the walls very sloping from the inside; the outer walls may be made more perpendicular, because there is no water from the outside to injure them. Having built the walls by using the earth from the inside of the reservoir, and everything ready for puddling the earth to hold water, the first thing in order is to plow up all of the land over the whole bottom surface of the reservoir, 4 or 5 inches deep, then with a harrow or drag, or other suitable implement, reduee the earth to a very fine pulverization, and after this shall have been done, and thoroughly done, the next thing in order is to make ready to puddle.

Having your team and that of your neighbor, if you can procure his services, with his team, with drags, or harrows, or inverted scrapers, or other suitable tools that will be best adapted for working

fine earth into mortar. Now, all ready to puddle, turn the water into the reservoir and begin to puddle at one edge, puddling carefully along this edge until the earth shall have been reduced to perfect mortar and continue to work toward the other side until you have completed the entire bottom of the reservoir as far up on the embankment as you can work with your team to good advantage.

If you have done the work thoroughly and without stopping after you have once commenced until it is all finished, your reservoir will then cement into a good solid bottom that will hold very well. After you have your reservoir thus made and puddled, the next thing is to provide some means to prevent the embankments from being washed down by the continuous waves of water which are caused by the wind. Many different schemes have been employed for this purpose and none of them with that degree of success that it is hoped will be obtained by further experimenting in the near future. Some of the Irrigators use sod for protecting the walls on the inside by laying the sodded blocks in the same manner now employed by landscape gardners in sodding lawns and houseyards.

If stone can be had, the better way will be to rip rap the embankment on the inside, as it would be the more permanent and as a rule give better satisfaction. Some Irrigators have used planks thrown onto the water, which will float and be driven by the wind to the opposite side of the reservoir from which the wind blows, the planks acting as a break-water to prevent the walls from being destroyed.

When the wind changes these boards blow over to the other side again and thus continue to protect the walls, no matter from which direction the wind blows. This last plan—of boards—is not as good as the sodding in the estimation of many who have used both systems.

Another plan is to rip-rap the inside walls with brush and weight them down with stone, or hold them down by staking them. In this case the twigs and limbs of small trees and bushes are laid down against the wall in a compact mass, and as thick a mass as the supply of the material will permit. This has been found to give very good results. If the walls have been sodded inside, instead of being protected by boards, or brush, or stone rip-rap, it will be well if some water-grass can be procured from sloughs and planted in the seams between the blocks of sod, so that by the time the sod rots out the water-grass may have taken firm root, so as to form a living protection to the embankment.

The outside walls of the embankment may be sodded, or they may be planted with such grass as Irrigators prefer, such as blue grass, or other tame grasses. To maintain your reservoir in good order never allow it to go dry. If you do the bottom will dry out and crack open, which will require it to be replowed and repuddled, requiring just as

much work to make it hold now as it did to make it hold in the beginning; for the same reason do not allow the ground to freeze. Freezing is just about as bad as leaving it go dry. To avoid freezing slways keep two feet or more of water in your reservoir during winter.

We have now learned how to maintain a reservoir full of water, but to get it out onto the land is another thing. As we have located our reservoir on land of sufficient elevation, it will now only be necessary to find such a point of ground on the side that is the highest to locate our main ditch, i. e., the start of the main ditch. The bottom of the main ditch should not be any lower than the level of the ground, hence, it would be necessary to throw the earth up so as to make the ditch walls altogether a foot above the level of the ground. This keeps us above the level of the earth we wish to irrigate. If we have had no experience in irrigation we may not understand the advantage of keeping the water well above the level of the land that it is to flow over. In leveling up the land so that water may flow readily over it, you may be able to secure a sufficient quantity from the high point or knoll to be carried with the scraper, or other suitable means, to the land on which you are going to construct your main ditch. We will give a more detailed description of ditch-building in a future issue of THE IRRIGATION AGE.

To build a water-box with trap to carry the water from the reservoir to the ditch, the box should be made of plank two inches thick and long enough to reach through the bottom from the inner side of the embankment through the embankment to the outer side, so that the bottom of the box will be no higher above the ground than the bottom of the ditch into which the water flows from the box.

These boxes may be made in any width or height, such as 8 inches wide and 4 inches high, or 12 inches wide and 6 inches high, or 16 inches wide and 4 inches high, or 6 inches high, or 10 inches high, as may be most suitable. The capacity of the boxes should always be in proportion to the capacity of your reservoir. All of the lumber used in the boxes should be long enough so that the length of the board will be sufficient without splicing and should never be less than 2 inches thick. When the box is completed thus far, then saw one end of the box off at en angle of about 45 degrees, in such a way that the longest part may be on the bottom and the short side on the top and the widest part of the box should always lie on the ground and not edgewise. To make a trap-door for this box use a piece of lumber wide enough and long enough so that it will cover the end sawed off in the same manner described above.

To fasten it to the box, take leather and make it in form of a gasket and fasten the leather to the ends of the boards that you have thus sawed off so that when the lid, or trap-door, which is to be

hinged to the upper part of the box will fall down or lie down over the end of the box so that it will form a water-tight joint. Any kind of suitable hinge may be used to fasten the door or trap to the top of the box. The weight of the water will cause the trap to remain closed; if not, a weight may be added. A lever or suitable means may be used to open the trap when the water is to be let into the ditch. The trap end of the box must be on the inside of the reservoir, not on the outside.

The reservoir should be of suitable dimensions—50x100 feet or 100x200 feet, instead of 50x50 feet or 100x100 feet, for reasons hereinafter stated. In calculating the height of wall, measurements should always be made from the outside instead of the inside and from 5 to 6 feet in height above the level of the land.

The water lying in the bottom of the reservoir, below the land level, can not be used because it can not be taken into the ditch. The first foot above the land level is of comparative small value because of the low pressure and the slowness with which it forces the water through the ditch. For these reasons the water should never be allowed to be drawn closer than a foot above the level of the outlet of the reservoir.

Irrigators who employ their reservoirs as a fish pond will find it advantageous to maintain not only the water that lies below the level of the water box, but to allow six inches or a foot of the water that lies above the water box to always remain. By so doing they will not destroy their fish nor the reservoir by permitting it to dry up, or be injured by freezing in the winter.

It has been suggested by some Irrigators that good results would be obtained by planting around the embankments any variety of low growing bushes for the double purpose of protecting the water from the force of the wind, which disturbs it into waves to destroy the embankments, and to give to the reservoir that pleasing effect so much desired.

(To be continued.)

WHO BIDES HIS TIME.

Who bides his time—he tastes the sweet
  Of honey in the saltest tear;
And though he fares with slowest feet,
  Joy runs to meet him, drawing near;
The birds are hearlds of his cause,
  And, like a never ending rhyme,
The roadsides bloom in his applause—
  Who bides his time.

—*James Whitcomb Riley.*

SUCCESS IN THE WELL-MAKING BUSINESS.

Well-making, at the present time, is considered a business in itself—a trade, requiring skill and scientific knowledge; and, like every other business, tact, good judgment, energy and economy must be employed to make it successful. In early days, any man who had sufficient physical strength could dig a well. At the present time, only a part of those who embark in the well-making business become successful. And yet, taking into consideration the amount of capital invested, there is no legitimate, honorable business in this country from which as much clear profit can be derived, as can made in making wells with modern improved machinery.

The droughts which have prevailed over large sections of the country during the past few years have caused a very great increase in the demand for good wells. This demand is for better and deeper wells than heretofore, and better and larger machines must be used in making them. The purchaser of a good well machine can always find plenty of work to do, and at almost his own prices, provided he is a good workman.

Compare the profits of the ordinary farmer with those of a successful well-maker. A man with a farm of 160 acres in the West has at least $3,200 invested in his land, and $2,000 more in his stock and machinery. From such a farm, during a very good season, he may possibly sell grain and stock to the value of $1,600, besides paying for what help he requires and other necessary expenses. This is far above the average, as will be attested by many a farmer. From the investment of $5,200, and for the year's work, the farmer gets an income of $1,500.

Now, to start into the well-making business requires an investment of from $500 to $2,000, according to the kind of work that is contemplated. The ordinary farm outfit will cost about $800, including horses and wagon. The price per foot for making wells varies greatly, but probably averages between $1 and $1.50 per foot. From 30 to 100 feet can be bored in a day, and from 20 to 300 feet can be drilled in a day. At 50 feet a day, and at 60 cents per foot, a day's work would amount to $30. There are 300 working days in a year. At $30 per day, the year's income would amount to $9,000. "But," you say, "this is too much; I cannot find work all the time; the weather is sometimes bad." So we will deduct 100 days, which makes the year's income, working a little more than half the time, $6,000. But you say that the average price is not as high as we have figured it, or you cannot average 50 feet per day. Grant that this is so; that you cannot average but 30 feet per day, and that the average price per foot is only 40 cents; still your income would be $2,400 per year, and

all from an investment of $800 and for working about one-half the time. Now, leave it to any farmer if our estimate of the average farmer's income is not high and to any successful well-maker if our estimate of his average income is not low.

Look at it carefully. A farmer with $5,200 invested and 313 hard working days in the year, and a profit of $1,500, if the season is extremely favorable. A well-maker with $800 invested and only 200 working days in the year, and a profit of $2,400 at the very lowest estimate.

But the business of making wells is not, and need not, be confined to those who make it their sole occupation. It is a very profitable employment for the farmer, in the winter time, when both he and his teams would otherwise be idle. For the thresherman, also, it is a paying business, giving him work throughout the year.

Then, why is it that, with a constantly increasing demand for good wells, with improved machinery, with a maintenance of prices that would do credit to any "trust," with unlimited opportunities for study, advancement and progress, so few men enter into the business of well-making and of those who do enter, so few succeed?

Well-making, as a business, is in its infancy. Its surroundings and it environments, its commingling of hard work, long hours, mud, water and slush, its annoyances and unexpected losses, repel the ordinary business man and he will prefer more pleasent, even if less lucrative, employment. This is the reason that those who do undertake it are usually members of the farming and laboring classes. But on the other hand, well-making is a business which demands more than ordinary business ability, which requires tact, patience, skill and scientific knowledge. Farmers and laborers do not, as a rule, possess these necessary qualifications, and when they undertake such a business without preparation or experience, their failure is almost certain. The fact that they fail keeps others, who might succeed, from attempting it. It is more natural (and more self-complacent) to condemn business than to condemn those who make a failure of it.

The above are the principal reasons why so many men in search of a livelihood are averse to taking up the business of well-making. In this, in my opinion, they are making a mistake, and there can be no question but that with proper methods and means, the business can be enlarged and improved in its scope and made profitable as well.

What qualifications should a man possess in order to succeed in the business of well-making? The same as in any other business. He must be able and willing to work hard, at the same time to work intelligently. There are plenty of men who work hard from morning until night, every day in the year, who never rest or give up until

laid in the grave; and yet these men do not accomplish much—never attain success. They *do not work intelligently.* There is no method or system in their labor, no effort made to lighten or lessen it, no attempt to use head as well as hands. Such men would not succeed in the well-making business where, especially, intelligent effort and practical work are demanded. Some well drillers will diligently "turn cable" all day while their machines pound away on a stratum of flintstone without making any impression. Others will find out the character of the stone, sharpen their bits accordingly and, in a few hours' time, will have cut through the stratum. The man in the well-making business must learn to work to advantage, must learn to discriminate when, how and what tools and appliances to use. He must not only *work* but do his *work intelligently.*

The man in the well business must also be a good salesman. That is, he has wells to sell, and must find purchasers for them. "Good salesmen are born, not made." That may be true, yet most any man can improve his qualifications and increase his ability as a salesman. In starting out, remember three things:

Be always courteous and good natured, yet firm and persistent.

Tell the truth, keep your promises and appointments.

Adapt yourself to the man with whom you want to do business; don't try to sell a three hundred dollar well to a man who can't spend over a hundred dollars for one.

You will find that experience is a good teacher for the salesman. Don't get discouraged, but keep at it. If you can't secure plenty of work in one locality, try another. Establish a reputation and add to it as fast as you can. In a short time your customers will be seeking you, and your final success is then almost assured.

The well maker must also be a good "business man." He has contracts to make, settlements to adjust, credits to pass upon, notes and securities to obtain from delinquent debtors; besides, obligations of his own to pay or arrange for, and the one hundred and one things that every business man must attend to, no matter in what line he is engaged. Therefore, every man who is in the well-making business, or about to enter it, should strive for a good business education, not necessarily in schools, but in every way possible. Read and study some book on business law (Parson's is good), and consult a good attorney as to the proper form of contracts to use in different localities. When you have decided upon the proper form to use, have blanks printed, and *always use them.* Of all the wells that are make for hire, probably not over one-half are ever paid or settled for. For a large part of these, payments and settlements could have been enforced, if the contract for making them had been full and explicit in its terms and agreements.

Also study some good commercial arithmetic, and procure some good book on "Forms," to consult when needed (Eaton's "How to do Business," is good). Remember that no man ever acquired a surplus of knowledge, and do not be afra d to read and study whatever and whenever you have opportunity.

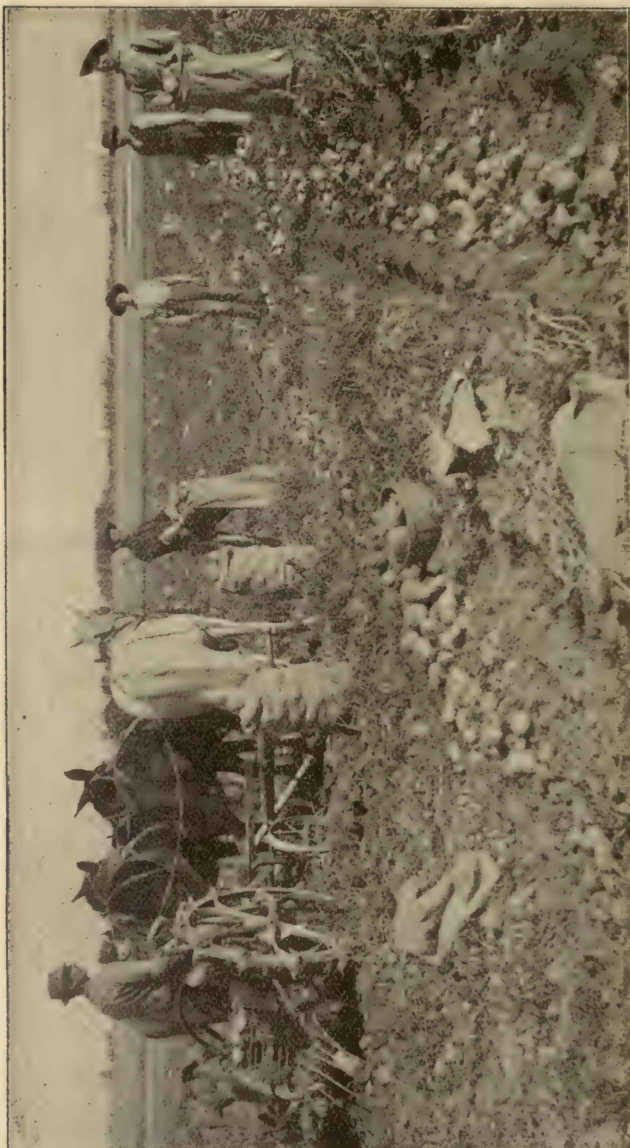
In this connection, however, I want to say, that to know or to do one thing better than other people is a great deal better than to know or do almost everything fairly well. Therefore, let your studies be in the line of your work. Become master of your business first; learn other things when you can do nothing else.

For the business under considertion, a good practical knowledge of geology and physics, particularly the subject of hydraulics, will be of the greatest advantage. Thoroughly master some elementary text book of each of these sciences, and then pursue the study of them in detail in all the subjects that relate to your business. The United States and state Geographical Reports especially, contain a great deal of information that is valnable and pertinent to the wellmaker. You must learn to procure and utilize all such sources of information and knowledge pertaining to your business if you would climb to the top of the ladder.

In this day and age of the world it has become fashionable to decry and deride that "old-fashioned honesty" which was "aiways the best policy." It is true that so-called "legal honesty" has in a measure and with some people supplanted the idea of honor, which, more than any other attribute, has been the means of ennobling the human race. No man starting in on a business career can, in my estimation, afford to deprive himself in any degree of the highest attribute of a true gentleman—honor. It certainly cannot hinder success; it may not hasten it; but the self-esteem and consciousness of worth which it engenders, the high ideals up to which it ever leads, are worth more to any man than mere worldly success, valuable as it is. Therefore in all your dealings, both with yourself and with your fellowmen, be not only honest; be *honorable.*

"Men succeed who are ready to succeed." Influential friends, capital and good fortune in those affairs beyond human control may be of great assistance to a successful man in hastening the hour of prosperity's high tide; but ninety-nine times out of one hundred a man will not fail for lack of them, but because he has not acquired that business ability which is made up of *business knowledge and everlasting push.* Success in the well business depends upon the energy the persistence and the good sense and skill of the man engaged therein. It is not recommended for a lazy man or for a man who is looking for a "snap."

POTATOES BY IRRIGATION.



A COLORADO POTATO FIELD.

In a recent letter from Mr. John G. Hall, Greeley, Colo., he gives us the following information about the potato industry as carried on with irrigation.

"During the season of 1901 about 7,000 cars of potatoes have been

grown in the vicinity of Greeley. This is an average crop for this section. The potatoes are shipped sacked, 3,000 lbs being a minimum car, and it is easy to estimate the number of bushels grown in this locality by irrigation. All varieties are not successfully grown, some being a total faiure.

Among the most successful varieties are the Rose Seedling, Manmouth Pearl, Carmen and Early Ohio.

Horace Eldred, living four miles north-west of town, sold the crop from three acres of potatoes for $880.00. They were harvested in the early part of September, 1901. His product was of the Early Ohio variety. Early potatoes are usually planted here the first week in April and harvested in August and September. The larger portion of the crop is planted in the latter part of May and early June and harvested in October.

The best seed obtainable is used, and planted in rows about 38 inches apart with one set, having two or three eyes, placed from 12 to 15 inches apart in the row.

The Aspinwall planter is largely used. It is used with two or four horses, according to conditions. This machine opens the row and drops the seed, one in a place, and covers it properly; it at the same time marks the next row. When the planting is done cultivation commences, and as much soil as possible is thrown onto the row, this being leveled off at night with a float, which destroys all weeds springing up in the row

Deep and frequent cultivation is necessary and should continue until the new potatoes are the size of marbles. At this time they are ready for irrigation, which should be done in every other row and hurried through, if the weather is hot, and from this time on the ground should not be allowed to dry out again. The irrigation should be done with small streams and arrangements made to hold the water on longer as the weather becomes cooler. From two to three irrigations are necessary to make a crop, according to amount of rainfall during that period.

Digging is done with a four-horse digger, which throws the potatoes to the surface and leaves the ground smooth. If marketed from the field they are put into burlap sacks and sewed. These sacks hold about 115 pounds. If taken to the dugout for later markets they are drawn in sacks and dumped into the shutes. A photograph of a Greeley potato field is herewith shown. JNO. G. HALL.

IRRIGATION IN TEXAS.

The following letter, recently received from Mr. F. F. Collins, San Antonio, Texas, is a fair illustration of what can be accomplished by irrigation. We present herewith a portrait of Mr. Collins, believing that many of our readers will be interested in looking at the likeness of a man

F. F. Collins, San Antonio, Texas.

who has made such a pronounced success. Following Mr. Collins' letter, is reproduced an article from the pen of a special correspondent of *The Texas Stockman and Farmer*, which gives a more extended description of this tract.

San Antonio, Texas, Jan. 29, 1902.

Editor Irrigation Age:

Having read The Irrigation Age for many years, I am pleased with it and would not be without it for four times its cost. I am what they called an irrigation crank until success crowned my efforts; then they say it is Collins' luck. Let it be luck or what-not, I will tell you how I did it and if you think this any benefit to the public do with it as you like.

One year ago I took hold of 140 acres of land inside the corporation limits of this city, a mesquite and cactus waste that would not support one Texas longhorn, drilled a well, got 1,000 gallons of good flowing water per minute, cleared and put the tract in good condition, made the proper ditches, built eleven good houses and a good barn with each house, run a 4-inch pipe attached direct to the well so that each family has a hydrant of as pure water as ever ran out of mother earth. I divided the tract into eleven plots and rented to eleven families at twenty dollars an acre. [Have it rented this, the second year, at $22.75 an acre.]

The investment stands today at twenty-one thousand dollars. Now for the result. There are about sixty contented and happy people living on this 140 acres and I have been offered forty thousand dollars for the property. Some of my tenants made two crops of corn (80 to 90 bushels the first crop and 50 bushels the second crop), others made one crop of potatoes, then, on the same land, made a crop of sweet potatoes, and after this was sold made a fine crop of turnips, netting for the year from three to five hundred dollars an acre. There was but one good rain during the winter and summer, and that was in July. Now if irrigation does not pay in this country please tell me what will pay.

Truly yours,

F. F. Collins.

THE ECLIPSE GARDENS.

Truck farming as a distinct industry in the vicinity of San Antonio is not anything new. In fact long before San Antonio reached to its present importance the truck

farming industry had gained for itself a position of some standing. But notwithstanding the rapid development of all other industries and the almost phenomenal increase of population of the city, the truck farming industry has made little if any perceptible progress. This is more strange in view of the most excellent advantages this vicinity offers for truck farming. Within a stone's throw of the city there lies thousands of acres of land most admirably adapted for truck farming and which may be purchased comparatively cheap. There are but few places in Texas that afford a better market for vegetable products and very few afford better transportation than San Antonio.

It is not to be supposed, hswever, that people failed to recognize these advantages. The reason why truck farming in the vicinity of San Antonio made very little advancement is because of one natural obstacle which was supposed to be insurmountable, viz., the drouths which often prevail in this section. In a small degree irrigation in some instances has been resorted to, the water being obtained from the San Antonio river and windmills. But it needed somethining more than that for a sufficient supply of water and which alone could furnish a stimulus for the development of the industry. This has lately been found in artesian wells.

It is due to the enterprise and foresight of F. F. Collins, a man well known to the people of every section of the state, that we are allowed to take a glimpse of what the future has in store for the truck farming industry of this vicinity. Much less than a year ago 140 acres of land belonging to Mr. Collins, lying about two miles from the heart of the city of San Antonio, presented almost the appearance of a perfect wilderness. The land was overgrown with mesquite and other kinds of brush, doing service to neither man nor beast. Mr. Collins decided that this should not be so, but that it should be put to the most practical and useful purposes, and he concluded to turn it into a truck farm that would eclipse all other such farms in Texas, and immediately proceeded to drill a twelve-inch artesian well.

In less time than it was expected Mr. Collins was rewarded with a genuine gusher soon after passing the 800-foot mark. The clearing and grubbing of the land in the meantime was going on at an active rate. Houses were built, driveways laid out, irrigation plants put in shape, and about the beginning of last April, in less than four months time since the first tree was grubbed, land was broken water turned on and seed planted and a truck farm came into existence which is destined to make its influence felt and give direction to the development of the truck farming industry not only in the vicinity of San Antonio but in the entire section of South Texas as well.

In company with Mr. Collins it was my pleasure to visit the Eclipse Gardens, where I experienced intense delight in what I saw. In approaching the entrance to the gardens my eyes fell upon the sign hoisted over the gate, painted in black letters the words, "Eclipse Gardens." The name struck me as being suggestive, and before I got half through with my observations I found that the name truly expressed the place, for it surely eclipses anything of the kind I ever saw in Texas. The farm is laid out with a system of driveways. Along one of the driveways is a row of twelve neatly built three-room cottages, which are used as dwellings by the renters. The farm is divided into twelve parcels, each one containing nearly twelve acres, and one of these portions is allotted to each dwelling.

The water is obtained from two artesian wells of a little more than 800 feet deep, drilled at a distance of about twenty-five feet from each other, and both having a discharge of 800 gallons per minute — one 700 and the other 100 gallons. The irri-

gation plant consists of a main ditch connected with laterals and controlled by a system of locks so that any one of the twelve sections can be irrigated at will without interfering with the others. From the laterals the water is conducted into the furrows. This system is what is known as furrow irrigation. In order that each of the tenants may have an equal show to irrigate his portion of the land, Mr. Collins has adopted an arrangement whereby each one of them gets the water every sixth day, allowing fifty-five minutef to the acre. Thus only two irrigate at any one time. In connection with the irrigation plant there is an immense reservoir of 4-000,000 gallons capacity, holding the surplus water, and which Mr. Collins recently stocked with fish.

The entire 140 acres are at present being cultivated by experienced gardeners though some of the land, owing to its having been grubbed late in the season, is planted to cotton and forage crops. After these crops are gathered all the land will be put in garden truck. These crops, however, present a striking and most interesting conteast to those planted on the farm adjoining Mr. Cellins' and which indicates the solution of the problem of successful agriculture in southwest Texas. Side by side, with only a fence as a dividing line, the crops in the adjoining field, consisting of cotton, corn and sorghum, are in a most pitiful condition on account of the drouth, while the same kind of crops on Mr. Collins' farm under irrigation are a delight to the eye, and judging from their present condition seventy-five bushels of corn or a bale of cotton to the acre is a perfectly safe estimate.

Among the vegetable crops now nearing maturity on the farm are tomatoes, cantaloupes, cucumbers, onions, melons, lettuce, etc. Some of the farmers are now gathering their second crop and are getting the land ready for the third crop. Radishes, coli-robi and lettuce are now being planted. In twenty days the radishes will all be gathered, a few days later the coli-robi and then the lettuce, when the land will again be made ready for cabbage, cauliflower and some other crops. The gardeners find a ready sale for their produce in the San Antonio markets, and I was told by some of them that they expect to cleor about $1,000 a year, and from the experience they have thus far had on the farm they do not think it will fall below their calculations

For the establishment of the Eclipse Gardens Mr. Collins deserves the plaudits of not only the people of San Antonio, but of the entire section of southwest Texas, for he has set a powerful example and a living illustration of how to reclaim a great portion of our semi-arid lands for the use and benefit of mankind.

CURIOUS WATER EFFECTS.

Prof. Israel C. Russell of the United States Geological Survey is at present examining the great lava covered plain of Southern Idaho, through which Snake River has cut its deep canyon. Many creeks and rivers rising in the mountains on both sides of this plain lose their water as they enter upon the pervious surface. These percolate under ground to finally reappear in great springs far down the canyon walls. Some of the streams from these springs are literally large enough to float a steamboat. It is the object of the Geological Survey to locate the course of these underground waters beneath the drouth stricken region and to indicate where, by deep wells, water may be had for the cattle or sheep which for lack of water are unable to graze over the broad area. There are many tracts of fertile land embracing thousands of acres which by the use of the waters now flowing to waste might be made into productive farms and orchards. This investigation is part of the general study of the water resources of the country, and the maps prepared will add to the series exhibiting the probable depth and character of the waters beneath the surface.

IRRIGATING A STRAWBERRY BED.

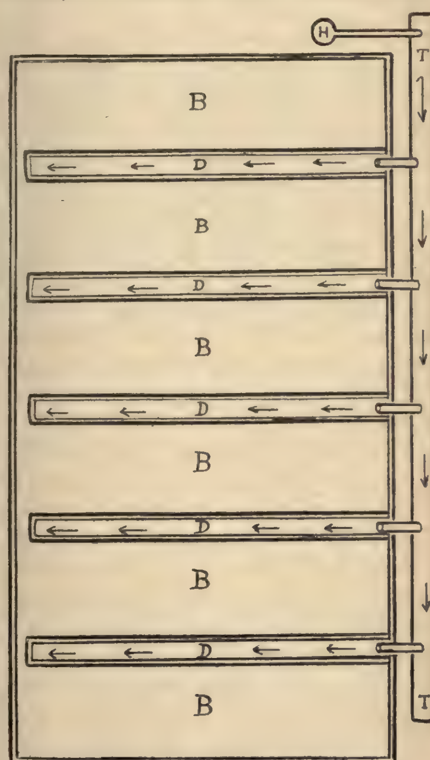
BY
MRS. CORO B. HILLMAN, Richland Centre, Wis.

Last spring, having received R. M. Kellogg's book, "Great Crops of Strawberries and How to Grow Them," I became interested in having a strawberry bed upon our lot, and caring for it myself, as I love to be out of doors, fussing with my bees, flowers and chickens. I sent to Mr. Kellogg for plants and took great pleasure in watching them grow. After

MRS. CORO B. HILLMAN.

every shower I cultivated the ground between the rows and around the plants. About the first of July the weather became very dry; I tried the dust mulch, and presume that might do for a little while, but think if I had not used water in such a long, continued drouth as we had last summer, my plants would have been numbered with the dead, very much to my regret. My husband would take his stand every night after supper, with hose in hand, and for nearly two hours keep the water going upon lawn, flowers and strawberries. He did not wet the strawberries every night, as we knew that would not be best, but his patience with the hose worked wonders in our yard, so it was a beauty spot, refreshing to look upon, when so many places about were brown and bare of vegetation.

This season we will make a long board trough, and place it upon the highest side of the bed, the hydrant being at one corner of the bed, and that, at the highest corner, the water can be let into the trough;



(H) Hydrant. (T) Trough. (D) Ditch. (B) Plant Bed.

flowing along, and out, at the little pipes into the ditches between the rows of plants

as shown in accompanying diagram. The pipes into the ditches can be made of lath, cut in two lengths, and nailed together sidewise, making a V shaped trough to fit into V shaped notches, cut in the side of the large trough. If the bed was quite large the trough could be moved along, irrigating a part of the bed at a time, conducting the water from the hydrant into the trough by means of the hose. I think this would be the cheapest and a very easy way to irrigate a small plot of ground. I will let you know later what success we have. I was first interested in irrigation by the study of conditions in the state of Washington and the immense crops of fruit, potatoes, alfalfa, etc., which they raise in some parts of the state under the irrigation ditch.

A DRY SEASON.

In reviewing the year's business at Chicago, which may be taken as fairly representative of the great cattle markets of the country, the *Live Stock World* says:

"While current belief was that the whole total of all kinds of cattle in the country was short, the market movement began early to show an increase over the previous year. But it remained for the beginning of the drouth period to start a volume of cattle to market that would astonish humanity and send statisticians back into the last decade of the nineteenth century for a parallel. The total receipts for 1901 exceeding that of the prievous year by 300,000 and providing the largest since 1894.

With the coming on of the drouth, which began to be seriously felt in July, an era of record breaking receipts was ushered in. There was a general rush from all over the corn states to get rid of stock and the markets were at once flooded with cattle in everything but killing condition. Since April 25th, 1892, the one day record for cattle receipts had stood at 32,677 but on July 24th, 1901, this record went to smash and since then 35,472 stands as the banner day's cattle record in the history of the Chicago Union Stock yards. The week of Sept. 19th, 1891, still stands as the banner cattle week, when 95,524 was the record, the highest week of this year having been for the one ending July 27th when 81,208 cattle arrived, but the year beats all former records for one month the September total having been 447,889 against 385,466, the former month record which was for September, 1892.

Up to the beginning of the drouth period the range of prices for beef cattle had stood comparatively narrow, in fact the spread between poorest and best grades was fairly normal, but when these drouth cattle began to pour in in numbers never before equaled at this market, which is equivalent to saying they were world beaters, there was an accompanying widening out in the range of prices. While in January the spread between cheapest 900 lb. killers and the best 1500 lb. beeves was $2.80 per hundred weight, in November it was $3 50. The narrowest range of prices for any month during the year was in June, when on deductions made from the weights mentioned above the extreme range was $1.90 At Chicago the top prices on Texas cattle each month for the past three years were:

	1901	1900	1899
January	$4 85	$5 90	$5 25
February	5 05	5 15	5 05
March	4 95	5 40	6 00
April	5 40	5 40	5 35
May	4 90	5 05	5 00
June	5 60	5 35	5 15
July	5 20	5 40	5 65
August	5 25	4 90	5 35
September	4 70	4 85	5 15
October	4 10	4 50	4 65
November	4 75	5 00	6 75
December	5 15	5 20	5 50
Top	5 60	5 90	6 75

WHERE TO BUY AN IRRIGATED FARM.

We are receiving many inquiries from thise seeking the best place to buy irrigated land. The demand for such property is becoming very great; in fact, all signs indicate that we are on the eve of an irrigation boom, not indeed after the stock or town lot order, inflated only to collapse, but a steady, growing demand, followed by a rise in values commensurate with the money-earning capacity of the property. Fortunate are they, therefore, who own or early secure such property, especially under an irrigation system just developed or developing where present prices are low.

Farm values in favored locations, under the impetus of good times, have greatly advanced, making it difficult for those wanting to own farms to buy at reasonable prices, while in some localities farms are being bought and sold at speculative prices. In consequence many farm owners are taking advantage of the opportunity to sell and invest their money in irrigated farms or cheaper western lands wherever favorable opportunities are offered.

The drouth which prevailed last season in many states has again emphasized the [illegible] of irrigation. It is certain also that the national government will in the near future give more attention to the subject. Both political parties have demanded it and the president in his last message strongly recommended that congress should take some action. The great railroads also, especially the Union Pacific, which heretofore, under the domination of the land department, has been encouraging the range interest rather than small farmers, has made a radical change in its policy and will hereafter lend its powerful influence to the development of irrigation systems and the settlement of the more productive and useful tiller of a small acreage along its lines. Great publicity has also been given to the subject of irrigation by the public press and a wide discussion of the subject is now going on. These are all factors contributing to enlighten the public on this important subject, which as the advantages of farming by irrigation become more fully and widely known will stimulate a still greater demand for such property.

Off to the Hay Field, Kuykendall Ranch, No. Platte Valley.

These advantages of farming by irrigation may be briefly enumerated to be,

1st. The control of the water supply to apply when needed. Thus when the water supply is ample, and those who buy irri-

gated farms should be well assured that such is the case, crops are sure and the element of chance largely eliminated.

2nd. Statistics show that the crops on irrigated lands, year in and year out, average about double those produced by "Providence farming," while to quote from the Wyoming Agricultural Experiment Station Bulletin, "an increase of two bushels per acre more than pays the cost of irrigation."

3rd. The quality of the product is also better under irrigation. This same wheat weighed 66 lbs. to the bu. Oats from the same fertile valley, exhibited at the World's Fair, weighed 56 lbs. per bu. Also the prize barley at the World's Fair, which also came from this valley, was produced by irrigation. The average potato yield under irrigation is also more than double that under ordinary conditions,

Feeding sheep on alfalfa. Five tons per acre raised by irrigation.

This same bulletin gives the yield of wheat produced at the station at Saratoga, North Platte Valley, Carbon Co., Wyo., at 40.2 bu per acre, at a cost of $7.30 per acre, yielding a very handsome profit, especially at the present price of $1.35 a bu. This yield is not exceptional, but under irrigation may be duplicated each year without fear of failure or damage. It is also no uncommon thing to cut 5 tons of hay per acre in a single season to supplement an extensive free stock range.

with nearly all of a marketable size.

4th. The hay and grain are also harvested without fear of damage by storms in the harvest season to beat down or rust the grain or sprout the shock or spoil the hay.

5th. On account of the limited area in the arid regions which it is possible to irrigate and cultivate, and the demand at the adjacent mines, a demand which must ever be in part supplied by products from the East, the prices of products rule high.

For example, the following market quo-

tations are from the Saratoga, Wyo., *Sun.* Saratoga is in southern Wyoming, Carbon Co., North Platte Valley, adjacent to the Grand Encampment mining district:

Oats, per 100 lbs	2.35
Wheat " " "	2.25
Flour, 50 lbs. sack........1.25 to	1.45
Graham, 25 lbs. sack	55
Corn Meal, 25 lbs. sack	75
Potatoes, 100 lbs	2.25
Cabbage, per lb..............4 to	5
Onions, per lb	5

Method of irrigating grain. The process is not difficult.

Butter, ranch	30
Butter, creamery	35
Eggs, per doz.............30 to	35
Hay, native, in stack, per ton	12.00
Alfalfa " " " "	10.00
Loose, delivered, per ton	13.00
Baled " " "	16.00
Baled " " " by bale	18.00

These are prevailing Nebraska prices plus the freight and handling. With such prices and in such a favored locality, where the irrigable land area is limited, and the adjacent mining section large, the farmer can always depend upon eastern prices plus the freight. On account of the rapid growth of the mining and manufacturing industries in the West, now going forward in leaps and bounds, a farm under such favored conditions becomes a veritable gold mine. With such prices and such yields and such crops there is nothing to hinder the thrifty farmer from prospering.

6th. Theae is still another advantage, which many esteem the greatest— the advantage of healthfulness. The arid regions are proverbially healthful, especially for weak-lunged people and those suffering with catarrh, asthma, rheumatism or any of the diverse disease products of a humid climate. They possess none of the enervating influences of a humid climate, or the penetrating cold of the humid regions of the north, but the climate is invigorating, producing strong men and women, mentally and physically. Also the element seeking the west are as a rule the most progressive, creating good society and prosperous communities.

With all these advantages it will be seen, viewed from a commercial standpoint, that irrigated farms, when their real value, measured by the money yield, is establish-

ed, will eventually command higher prices than attained by the best eastern farms.

In many older established irrigation districts, where values are established upon a commercial basis, such is the case.

One of the aforesaid inquiries, for example, comes from Canyon City, Col. The writer, who is seeking a place where he can buy cheaper irrigated lands, says "prices here run from $200 to $400 an acre."

Another, writing from Rocky Ford, says values there, in a few years, have risen from government price to $200 an acre.

Still another, grom Greeley, says he has sold his farm, which three years ago cost him $75 an acre, for $140 an acre and wants to invest in cheaper lands.

In California, where values have become established, it is next to impossible to get an irrigated farm with an ample water supply for less than $100 an acre, and from that up to several times that price. In many instances, at these prices, the water rights are subject to a heavy annual water rental tax.

Those wanting irrigated lands will find their best opportunity in newer fields, where, while possessing equal advantages for profitable farming, prices are yet low, but which will rapidly advance under the impetus of settlement and development.

Among others the aforesaid North Platte Valley, in Carbon Co., Wyo., heretofore a neglected opportunity, given over to ranchmen who have waxed fat on cattle and sheep, but which is now being developed by the construction of an extensive irrigation system, affords such an opportunity. This is the location selected after considering many other opportunities, for the Homestead Irrigation Settlement, which is being established on a broad basis and a popular plan, composed of thrifty, industrious, temperate people, the fifth successful settlement of like character established by Mr. Jas. W. Wilson, 79 Dearborn St., Chicago, the well known agricultural journalist who has perhaps been instrumental in establishing more successful settlements than any other man in the United States.

As the enterprise is backed by plenty of capital and the co-operation of the railways, and as the valley possesses a fertile, deep soil, an ample water supply, easy of application, with cheap lumber and coal at hand, the above splendid markets, a healthful climate and good society, with schools and churches already established, the settlement cannot fail but prosper, and as the price of land and water rights, under the popular plan under which the settlement is being promoted, as quoted from Bulletin No. Six of the settlement, only range from $10.50 to $13 an acre, on easy terms, with no water rentals, it would seem to afford all the advantages sought either for a farm home or a profitable investment in farm lands.

THE LACEY COMPROMISE BILL

Representative John F. Lacey, of Iowa, chairman of the committee on public lands has introduced a bill which was intended by him to solve the irrigation problem so far as it confronts the present congress. Various irrigation bills have been introduced, and the committee on irrigation of arid lands has prepared a general bill, which has been reported in the senate, disposing of all of the proceeds of the public lands, turning them over for an irrigation fund, and embarking upon general, comprehensive and sweeping plans of irrigation throughout the entire arid regions of the United States.

This proposition is meeting with much opposition in the states that do not require irrigation. A special committee from seventeen states agreed upon the bill as reported in the senate, but in fact the bill was the result of a compromise, because they felt that they must agree upon some proposition as a unit.

The house committee on public lands has been investigating this question for a number of years, and Mr. Lacey's idea was that some experiment ought to be tried before any comprehensive and general plans of irrigation are undertaken. He has has introduced a bill which is intended to try an experiment of national irrigation. It is believed that this bill may be accepted as the only practical solution of the question. Of course, the gentlemen who are desirous of having the government committed to some general policy and system of irrigation will not be satisfied, but

it is not likely that any such general proposition can pass the house, although in the senate the large vote from the arid states is a very important factor.

The power in the house of New York and Pennsylvania amounts to sixty-one votes. In the senate, instead of having sixty one votes, or in that proportion, these great states have only four, while Nevada and Idaho have four. It is therefore evident that the general bill would have much smoother sailing in the senate than it would have in the house.

Mr. Lacey's bill proposes to authorize the secretary of the interior to select a tract of land not exceeding one million acres, situated in two or more states, or in a state and territory, or wholly within a territory, and to set apart the same as an "experimental national irrigation district." His idea is to make it an inter-state or territorial proposition, as thereby a district would be selected that a single state could not possibly handle, because the land and water would not be both within the states controlling the work. Of course, the land in a territory would be wholly within control of the national government, and that would make it a national proposition. The secretary, having selected the land and organized an irrigation district, would be empowered by the bill to use wide discretion in his method of reclaiming land and furnishing water supply. The land under the bill would be opened to homestead settlers: and the secretary would have the right, where the land is fruit land, to reduce the size of the homestead under the ordinary 160 acre limit.

DR. FREDERICK HAYNES NEWELL.
Chief Hydrographer of the United States Geological Survey.

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D. H. ANDERSON, - - Editor.

In Congress. Up to the present moment the beet sugar men seem to have the upper hand in the Cuban controversy, if they do not actually control the situation.

The wisdom of their course remains to be seen.

President Roosevelt has expressed, in no uncertain terms, his determination to promote the interests of not only the West, but the whole country, through the permanent establishment of a national system of irrigation.

This official declaration was conspicuous as a radical departure from the beaten track of former administrative policies, and presaged a larger service and less restricted activity, sectionally, than is recorded of Roosevelt's predecessors.

Something definite, of incalculable value—the vitalizing essence and energizing influence of a latent empire—was promised; something the whole nation might proudly consider the master stroke of statesmanship in an era of crowding commercialism and impatient industry.

And now the congressional mill is clogged with contention.

Not all sugar beets are grown by irrigation, but it is safe to say the greater portion and better quality of the American product depends upon an artificial water supply, besides, the western soil and climate, peculiarly adapted to sugar-beet culture, have future attractions for growers and manufacturers not found elsewhere, thus fixing the home and active field of this important industry in the now arid West.

Hence, if beet sugar seeks fair immediate political fate it may be well for the magnates controlling the American product to carefully consider greater prospective advantages before pressing claims of temporary value calculated to prejudice the

good intentions of the administration.

This point is made not in the belief that the President would resort to vindictive measures foreign to a brave nature, but that the inevitable compensations of policy beyond his control would be felt by other interests depending on irrigation in proportion as the pending measure for the relief of Cuba is threatened or obstructed by the beet sugar contingent.

The case is not without its perplexing features and stubborn complications, fully provided for by the wisdom and discretion of the statesmen who are facing a great opportunity where the short-sighted antagonist is usually at a disadvantage, and as between pugnacious commercialism and intrepid patriotism there is but one choice.

Beet sugar is a toothsome product, but the soil of the great West grows other staples even more numerous and essential to the welfare of the American citizen.

More Sugar. The following statement to a Washington correspondent by one of the leading beet-sugar men suggests that the Cuban war in congress is really between the growers of sugar beets and the sugar trust.

In any event the people pay the tax.

The item may be taken for what it is worth:

"When we sift the question down to its last analysis," he said, "this is the fact: We can stand a cut of 20 or 25 per cent. and will not suffer any appreciable injury from it, provided the cut is made in such way that the sugar trust cannot get the reduction and use the money in fighting us in the western market. The fact about the whole business is that the sugar trust hopes to capture about 50 per cent. of whatever reduction congress may grant, and to use those millions in making war on our industry by cutting sugar prices in the Mississippi and Missouri valleys, We know this, and it is our only opjection to the proposed reduction. Grant the reduction in such way that the trust cannot get its fingers on about half the sum remitted, and we will be content. But we would be the biggest fools on earth if we sat still and permitted our enemy to put his hands in the United States treasury for funds with which to fight his battle against us."

A Significant Event. At the banquet of the National Business League in Chicago on February 27th, a spirited interest in the movement to reclaim the arid west characterized the purpose of the occasion, and gave special point to the addresses of some of the most distinguished representatives of American business enterprise.

The sentiment of the evening was well expressed by Hon. Leslie M. Shaw, the new secretary of the treasury, when he said:

"With the same fostering that other nations afford, American ships will carry the products of our mines and of our farms, our fields, our folds, and our factories beneath all skies and into all lands, and America will become the workshop of the world, where he who seeks to sell his labor shall find abundant employment, and he who employs labor shall find abundant market, thereby contributing to the comfort and the contentment of all."

While the object of the occasion was plainly the recognition of our expanding commerce and the importance of seizing every foreign opportunity for larger trede, no speaker failed to emphasize the supreme importance of that greater home market and its varied sources of inexhaustible supply promised by the national irrigation movement.

In this connection Secretary Shaw's figures indicating the volume of business measured at Chicago as the great storehouse and distributing point of western products are truly astonishing.

From his carefully-prepared statistics we learn that:

"Chicago sends eastward over trunk lines of railroad 150 tons of provisions each hour of the calendar year; Minneapolis exports 4,000,000 barrels of flour per annum; Duluth and Superior forward by way of the lakes 65, 000,000 bushels of grain; Duluth, West Superior, and Milwaukee receive from the East cargoes of coal aggregating 3,000,000 tons per annum; Buffalo receives

from the West, and by tho same great waterway, 150,000,000 bushels of grain; Escanaba, Duluth, and Two Harbors ship 12,000,000 tons of iron ore; while Ashtabula, Cleveland, Conneaut, and Chicago unload an equal amount from more than 7,000 vessels that annually enter their harbors.

"The Detroit River floats four times as much tonnage as passes through the Suez Canal and one and a half times the aggregate of all vessels engaged in foreign trade that enter our ports on the Atlantic, the gulf, and the Pacific seaboard, an amount about equal to that of London, Liverpool, and New York combined."

This may be regarded as western commerce, and for the purpose of his illustration that vast territory, "the west," included "Michigan, Indiana, Missouri, Ok lahoma, Indian Territory, and all west of of these, and all north and west of Texas.

"These States produce," he said, "more than 70 per cent. of the nation's cereals, and 70 per cent. of the nation's hay. They contain 50 per cent. of the milk cows and 60 per cent. of all other cattle; 65 per cent of the swine, 75 per cent of the sheep, and where, except in the West, would you look for 80 per cent. of the wool?"

From the above it will readily be seen that our future commercial and industrial advantages are centered in and depend upon speedy reclamation and development of arid America.

The timely import and great comparative value of Secretary Shaw's concise summary of western productivity adds to the force of official statement every practical reason for united support of a national irrigation system.

His mathemaaical logic should disarm conservative eastern prejudice and spur the popular pride of commercial supremacy which is impossible to the east alone.

Referring to the crowded condition of agricultural industry following the growth of population as observed in Illinois, Wisconsin and Iowa, where the maximum capacity under present methods has been nearly attained, Mr. Shaw continued:

"If all the arable land of Iowa were put in crop, and that portion not needed to support the teams necessary for its cultivation placed on the market, the people of the United States could not consume it, though restricted to a cereal diet. The only way the yield of this unequaled 56,000 square miles of land can be consumed by 80,000,000 people is to have large quantities of it first manufactured into beef and pork and dairy butter. Our increasing population renders it improbable, however, that this remarkable showing can be long continued, even by Iowa, though she may increase to some extent her cereal production.

"The only hope of a material increase in agricultural products is through irrigation of arid lands. I see no objection to some provision that will encourage private capital to enter what may be made a most inviting field, and it seems to me this can be done in such a way as will place these lands upon the market at government prices. plus the cost of irrigation, and when paid for permit the purchasers to become co-operative owners of the irrigation plants.

"Let every industry be encouraged, let every enterprise be fostered, let every interest be conserved, then shall we grow great and symmetrical, and, growing great, shall preserve our industrial and commercial independence, and thus become an ever-increasing blessing to the world.

"The West not only grows food products, but her people have become no mean competitors in their preparation. Minneapolis alone manufactures 16,000,000 barrels of flour per annum, a carload (60,000 pounds) every ten minutes, day and night, 365 days in the year.

"A branch factory in a prairie town of Iowa of less than 4,000 population produccs 6,000,000 cans of condensed milk per annum, while the parent plant in Wisconsin makes more than double this amount, a portion of which helps to feed the standing armies of Europe and to supply the belligerents in South Africa.

"The Elgin Butter companies consume the cream from 70.000,000 pounds of milk, manufactures 3,000,000 pounds of butter (1,500 tons), and exports its products to China, Japan, Cuba, Mexico, South American countries, and to Alaska.

"A single unincorporated firm in south-

west Iowa handled last year 3,000,000 pounds (more than 100 carloads) of poultry. Another firm in the same State marketed in a single year 1,500,000 dozen eggs, sending them to the Atlantic, the gulf, and the Pacific coasts, while a third firm ships dressed poultry, not by carload only, but by trainload.

"The product of packing houses west of the Missouri River sells on the market for an amount in excess of the postal receipts of the United States, while a single institution, engaged in the preparation of animal products, whose parent plant is in this city, produced last year more than 10,000 carloads, 900 tons a day, of manufactured products, in addition to its meats.

"The packing-houses represented in Chicago yield a larger gross income than all the customs-houses and internal revenue collectors of the United States, while the value of the live animals sold on a square mile of ground within the limits of this city is only 15 per cent. less than the gross earnings of all the railroads that enter Chicago.

"Either of two packers within the territory I represent pays more for live animals to the enrichment of the ranchman and the farmer than is paid in dividends and officers' salaries by all the railroads in the United States, operating 190.000 miles, transporting more than 5,000.000 passengers, and moving 500,000,000 tons of freight.

"California is known as a gold-producing State, and her mines have yielded to date in excess of $1,250,000,000, but her orchards and vineyards are a close second. They produced in 1900 250,000,000 pounds of cured fruits and 7,000.000 cases of lemons and oranges. Her farms responded with 32,000,000 bushels of wheat, 25,000,000 pounds of butter, 5,000.000 pounds of cheese, and 11,000,000 pounds of hops. She manufactured 65.000.000 pounds of sugar, and sent through the Golden Gate more than 1,000,000 barrels of flour, and exported $15,000,000 worth of other agricultural products, while her forests yielded 500,000,000 feet of lumber.

"Washington has a fame worldwide for her fisheries, and her forests cut 1,000,000,000 feet of lumber and 3 000,000,000 shingles. The fisheries of Oregon yield $3,000,000, her mines $4,000,000, and her farms and orchards $50,000,000. Her manufactures, including lumber, are worth $60,000,000. California, Oregon, and Washington estimate more than 400,000,000,000 of lumber yet standing in their forests, 100,000,000,000 more than government experts estimate in all the territory of the United States outside that portion which I here represent.

"Michigan, Wisconsin, and Minnesota have more than a national reputation for their lumber interests, yet the mines of these three Western States produce 75 per cent. of the nation's output of iron ore, more than all the German Empire, and about the same as Great Britain and France combined.

"Colorado produces nearly 40 per cent. of our gold and more than 40 per cent. of our silver. Montana has produced during the last five years more than 40 per cent of our annual product of copper.

"I count myself fortunate, therefore, in being permitted to speak for 99 per cent. of the gold and the silver and the copper; 90 per cent. of the zinc, 75 per cent. of the iron, all the lead, all the nickel, and all the quicksilver, an aggregate of more than $250,000,000 worth of metallic minerals per annum, nearly 80 per cent. of the nation's output.

"While it is true, as I have stated, that the production of grain within the territory I represent has not increased as rapidly as her population, it is an encouraging fact that her manufactures, her commerce, and her banking facilities have increased more rapidly than in the nation at large. The United States increased her manufactured products 70 per cent. between 1880 and 1890, but the States for which I speak increased theirs 112 per cent. during the same period. This country manufactures $13,000,000,000, an amount in excess of the output from all the factories and all the shops of Great Britain and Germany combined by more than $3,000,000,000. This enormous showing records an increase of 40 per cent. in the last decade, but the territory I have defined made an increase in the same period of 45 per cent.

"The territory I represent imports, through customs districts located within its limits, merchandise valued at $85.000,000 and exports $120,000,000 worth. The banks within the same territory hold $1.500,000,000 deposits, and their clearings exceed $15,000,000,000.

"But I am not so much interested in the work of any particular location as I am in the inauguration of such means and policies as shall open the way for yet increased

American activities. The Pacific Ocean is ours, and the gulf is ours. Let those join hands, not across, nor over, but through the isthmus, and the Atlantic shall be ours. Discover means for informing our people what distant portions of the world require, and it will be produced."

Mr. Shaw's address was received with demonstrations of approval which place the National Business League squarely at the front of the national irrigation movement.

Representing such unlimited resources the positive stand taken by the Business League brightens the outlook for early activity in congress, and brings new hope to the believers in the greatness of the West.

Our limited space will only permit an extract from one other notable address:

In arguing for the reclamation of arid lands Cornelius J. Gavin, of New Mexico, said that of the remaining 600.000.000 acres of available government lands 100.-000,000 acres were susceptible of irrigation, if steps were taken by the government to save the forests and store the floods.

"The government," he said, "would be simply investing for the time being a part of the nearly $400,000.000 it has received from the sale of its Western lands until the sturdy pioneers could pay back every cent the government expends to give them an opportunity to build up an agricultural empire, as they did elsewhere in their westward march from the shores of the Atlantic.

"Every citizen of the country would feel a benefit from the development of this vast area; the factories of New England, as well as the great plants of the middle West, would all receive their share of the business, and all this at a cost to the government of not one cent, but the temporary advancement of money, to be paid back by those benefited.

"The upbuilding of greater Chicago depends in a great measure on the adoption of this government policy. You have been identified with all Western interests; you have put your earnings into the development of the West. Thus you are part and parcel of us in this undertaking of encouraging government aid, and we need you and we want you.

"Nothing seems too great for Chicago to undertake. A people who can make a drinking fountain of the Chicago River and start what will undoubtedly become a great waterway from the lakes to the Atlantic certainly could not fail or fall down on such a simple proposition as irrigating 100,000,-000 acres of land.

"Render this land tillable, and every one of the 100,000,000 acres will be settled upon and improved by the homeseeker. Towns and cities will spring up, the wealth of our nation increase, and what is greater and better than all, there will be an opportunity given for the better development of the typical American citizen, one who breathes free air on his own ground."

A Good Medium. Appreciation is always gratifying and is the more pleasing when merited. The IRRIGATION AGE takes pardonable pride in presenting some interesting testimony as to its influence on home seekers offered by an enterprising firm in a bustling north Georgia city.

The correspondence which speaks for itself is here presented:

TALLAPOOSA, GA., March 12, 1902.

THE IRRIGATION AGE,
112 Dearborn St.,
Chicago.

GENTLEMEN:

The page advertisement of our business, prepared by you, is certainly a stunner, and we expect to get some good results from it. We have already received a good many inquiries, and you may be sure we are highly pleased with the IRRIGATION AGE as a land advertising medium.

Thanking you for your attention, we are

Yours very truly,
The Greeley Land and Promotion Co.
By G. M. Greeley, President.

The Greeley correspondence is suggestive. It calls attention to the possible advantages of striking a new trail. It proposes the benefits of innovation. The Greeley Co., a Georgia organization, makes its enterprising announcement with true southern courage to a strange audience, through an unaccustomed medium, and with no special interest in irrigation

has attracted the attention of irrigationists, which proves two things:

1. Irrigation is becoming a popular question, whose students believe it can be successfully applied east, west, north or south.

2. THE IRRIGATION AGE reaches, interests and influences the public.

THE KING.

(BY MRS. J. K. HUDSON.)

In all the story of the world of man,
Who blazed the way to greater, better things?
Who stopped the long migration of wild men,
And set the noble task of building human homes?
The learned recluse? The forum teacher?
The poet singer? The soldier, voyager,
Or ruler? 'Twas none of this proud line.
The man who digged the ground foretold the destiny
Of men. 'Twas he made anchor for the heart;
Gave meaning to the hearthstone and the birthplace,
And planted vine and fig tree at the door.
He made e'en nations possible! Aye, when
With his stone axe he made a hoe, he carved,
Unwittingly, the scepter of the world.
The steps by which the multitude have climbed
Were all rough-hewn by this base implement;
In its rude path have followed all the minor
Arts of men. Hark back along the centuries,
And hear its march across the continents.
From zone to zone, all 'round the bounteous world,
The man whose skill makes rich the barren field,
And causes grass to grow, and flowers to blow,
And fruits to ripen, and grains to turn to gold—
That man is King! Long live the King.

PRACTICAL RESULTS OF THE PRODUCTION OF SUGAR BEETS IN THE ARKANSAS VALLEY OF EASTERN COLORADO AND WESTERN KANSAS.

BY JNO E. FROST.

"The proof of the pudding is in the eating" is a homely old adage which is an eminently safe and practical rule to apply to all lines of business. There are few branches of farming, or of business, where such accurate and complete information from actual experience can be obtained as in the production of sugar beets and relative to the receipts from the sale of them to the beet sugar factories, because of the systematic methods and accurate accounts employed between the beet sugar factories and their patrons, hence the sugar beet pudding is easily sampled.

WORK IN THE BEET FIELDS.

The second season of raising sugar beets and of the manufacturing of beet sugar, in the Arkansas Valley in Eastern Colorado, has just closed, while the season of 1901 was the first season of sugar beet culture in Kansas, under the act passed by the Kansas Legislature one year ago, providing for the payment of a bounty of one dollar per ton upon sugar beets raised in this State containing 12 per cent., or more, of saccharine matter. It is interesting to study the figures obtained and while it is a matter of regret that a complete statement can not be presented in this article, giving the experience of all of the sugar beet growers in the regions named; the tables herein presented will give the reader a very fair understanding of what has been done and of the results to the farmers in those regions.

The following tables, showing the results obtained in 1900 and

1901 by the farmers at Rocky Ford and vicinity, in their dealings with the American Beet Sugar Company operating the mammoth beet sugar factory at Rocky Ford, as compiled by "The Rocky Ford Enterprise," includes the names of only a few of the many who are profitably engaged in raising sugar beets, but the generalizations in connection with each table give a very good idea of the general results. The tables are as follows:

WHAT WAS DONE IN 1900 IN COLORADO.

Acres......	NAME AND TOWN.	Gross Am't...	Average Am't Per Acre....	Average Tons Per Acre...	Average Per Cent. Sugar	Average Per Cent. Purity	Average Price Per Ton....
10	Anton Wilson, Manzanola	$1,286.89	$128.69	26.20	18,2	85.6	$4.90
3	G. W. Seward, Rocky Ford	359.45	119.81	28.70	15.0	82.2	4.17
4	W. H. Billinghurst, Rocky Ford	467.73	116 93	25.89	16.6	83.1	4.51
4½	J. H. Whittenburg, Rocky Ford	522.42	116.09	30.90	15 1	81.4	4.22
9	I. D. Dale, Rocky Ford	1,004.30	111.59	24.73	16.7	84.1	4.51
4	J. W. Belew, Rocky Ford	433.78	108.45	24.55	16.4	83.6	4 42
5	D. L. Owens, Rocky Ford	538.70	101.74	25.79	14.8	80.6	4.17
6	Effie F. Mathews, Rocky Ford	640.18	106.69	23.35	17.0	83.1	4.57
10	A. P. and B. B. Kouns, Rocky Ford	1,058.07	105 81	25 40	15.3	81.1	4.17
4	T. B. Bash, Rocky Ford	417.28	104 32	22.96	17.0	83.4	4 54
2	M. A. Gordon, La Junta	207.49	108.74	22.44	17.2	83.1	4.62
1	C. J. Samples, Rocky Ford	101 64	101.64	22.00	17.3	85 6	4.63

For the crop of 1900, in addition to the figures given above, thirteen growers received more than $90.00 per acre; twenty six above $80.00; thirty five above $70.00; fifty-five above $60.00; sixty-seven above $50.00, and eighty above $40.00.

RESULTS IN 1901 IN COLORADO.

Acres......	NAME AND TOWN.	Gross Am't...	Average Am't Per Acre....	Average Tons Per Acre ..	Average Per Cent. Sugar	Average Per Cent. Purity	Average Price Per Ton....
2	Jno Klinkerman, Las Animas	$ 293.28	$146.64	28 1	19,0	84.8	$4.17
7.3	C. F. Kouns, Rocky Ford	1,035 16	141 80	33.1	15.3	82 2	4.28
4.8	J. F. Outt, Jr., Fowler	642.94	133.94	29.1	16.3	82.4	4.59
7	J. B. Hunt, Rocky Ford	836 90	119.56	26.0	16.6	82.3	4.58
3.1	R. P. Johnson, Rocky Ford	355 16	114.57	24 7	17 2	84.0	4.64
5.1	M. D. L. Haight, Rocky Ford	582.62	114.24	25.8	15 9	81 2	4.42
3 4	W. H. Robnett, Pueblo	358 96	113.51	21 3	17.8	84.1	4.95
4	S. E. Morrow, Rocky Ford	450 94	112.74	24.0	16 8	83.2	4.69
1.8	J. W. Holcomb, Manzanola	197 94	109.96	20.0	19.7	85.3	5 48
5	Robt. Harriott, Rocky Ford	542.97	108.55	25 7	14 9	81.4	4.22
1	C. J. Samples, Rocky Ford	107.76	107 76	26.0	15.8	82.6	4.14
2	S. C. Chilson, Lamar	207 40	103.70	20 7	18.1	84.4	4.99
4 3	D. E. Smith, Rocky Ford	442.70	102.95	22 5	16.8	82.6	4.57
2	David Eacy, Manzanola	202.85	101 42	19.3	18.6	84.1	5.24
8 9	J. M. Little, Rocky Ford	902.48	101.40	21.2	17 4	83.4	4.76
9.3	F. D. Hahnenkratt, Manzanola	[illegible]	101.61	21.3	17.0	83.2	4.73
1.5	Conrad Auschbeck, Canon City	151.37	100.91	20.0	18.7	84 5	5.02
22.4	B. F. Stauffer, Rocky Ford	2,259 48	100 87	23.7	15.6	82.0	4.25
10.3	J. P. Mullowney, Rocky Ford	1,036.12	100.59	22.6	16.4	81 9	4.45
6.8	T. A. Golden, Rocky Ford	681.56	100 23	21.4	17.0	83 0	4.68
9	W. A. Crum, Rocky Ford	900 25	100.03	20.9	17 4	82.7	4.78

For the crop of 1901, in addition to the figures given above, eleven growers received more than $90 00 per acre; thirty-five above $80.00; seventy-two above $70.00; one hundred and eleven above $60.00; one hundred and forty-six above $50.00, and two hundred and twenty-seven above $40.00 per acre.

During the campaign of 1900, which continued from Oct. 10 to

Dec. 9—sixty days—41,656 tons of beets were converted into refined sugar.

The campaign of 1901 was longer, extending from Oct. 2 to Jan. 15, a total of 105 days. The tonnage of beets sliced more than doubled the work of the previous year, aggregating 93,851 tons.

The Orange Judd Farmer offered some prizes last season, to the beet growers who realized more than one hundred dollars per acre from their crops in the Rocky Ford region, and the farmers who entered this contest were subjected to the most rigid scrutiny, and exact rules governed the contest, which were enforced by inspectors appointed for the purpose.

The following table contains the results obtained by these contestants:

List of contractors of the American Beet Sugar Company contesting for the prizes offered by *The Orange Judd Farmer*, season of 1901, with results obtained.

Name and Address.	Net Weight..	Sugar Percentage.			Pupitx.			Amount.
		Lowest..	Highest	Avg.. .	Lowest..	Highest.	Avg....	
D. V. Burrell, Rocky Ford	78,624	13.3	17.1	14.6	76.6	84.1	80.2	$160.07
H. Rednour, Fowler	66,468	18.0	20.9	18.9	82 0	84.9	83 5	158.09
J. W. Belew, Rocky Ford	74,306	13.8	17.7	16.1	79.2	85.3	82.3	157.25
I. F. Outt, Jr., Fowler	64,342	16.7	18.8	17.9	81.9	85.6	83 8	153.26
B. B. Kouns, Rocky Ford	71,784	13.7	17.7	16.0	80.9	84.8	82.0	152.48
M, G. Anderson, Rocky Ford	68,793	15.2	17.5	16.2	79.7	85.3	82.3	149.23
C. T. Kouns, Rocky Ford	72,011	12.0	17.1	14.6	75.2	84.1	80.1	147.85
Warren Blinn, Rock Ford	60,449	14.7	17.6	16 4	77.5	87.2	82.6	132.39
J. F. Crow', Rocky Ford	57,103	16.1	18.7	17.3	81.1	86.1	84 3	131.74
R. P. Johnson, Rocky Ford	53,957	15.4	19.0	17.7	82.2	85.2	83.4	128.96
I. D. Hale, Rocky Ford	62,569	12.0	14 8	13.4	77.8	83.3	79.5	125.13
W. B. Brown, Manzanola	55,895	13.7	17.9	16.3	76.6	84.8	81.9	121.71
Chester Johnson, Rocky Ford	51,285	14.2	18.0	17.2	79.8	85.7	83.5	119.70
A. F. Buck, Granada	47,601	16.1	19.0	17.7	80.2	85.0	82.8	114.38
J. W. Setters, Manzanola	44,387	17.0	19.8	18.3	76.9	84.3	80.8	109.83
Jas. Hammon, Manzanola	39,690	17.2	19.1	18.3	84.3	86.2	85.3	99.87
A. P. Kouns, Rocky Ford	46,545	13 3	18 8	15.5	76.7	82.9	81.3	98.75
J. H. Crowley, Rocky Ford	45,495	13.1	15.8	14.2	80.2	86.0	82.1	91.00
P. K. Blinn, Rocky Ford	41,683	12.3	15.2	13.5	80.0	86.7	80.8	83.36
Albert Conner, Rocky Ford	34,495	16.3	18.7	17.5	78.1	85,6	82.6	81.77
S. S. Bailey, Rocky Ford	33,579	16.9	19.0	17,9	83 8	85 5	84.4	80,44
E. B. Johnson, Fowler.	31,725	16.1	19.8	17.8	82.4	85.2	84.1	76.23

The following table from *The Farmer* of March 1st shows that Colorado growers received $870 in prizes, of which sum $785 was won by Otero county farmers.

Amount of Prize.	Names of Prize Winners.	Gross Sugar in Crop, lbs.	Cost of Raising Crop.	Profit from Contest acre.
$200	J. W. Bellew, Rocky Ford	11,963	$63.90	$ 93.34
150	B. B. Kouns, Rocky Ford	11,485	69.60	82.88
100	D. V. Burrell, Rocky Ford	11,479	82.71	77.38
75	Henry Redmore Manzanola	11,444	37.50	120.59
50	M. G. Anderson, Rocky Ford	11.173	23.50	125.73
50	C. F. Kouns, Rocky Ford	10,514	65.25	82.60
25	I. D. Hale, Rocky Ford	8,384	54.75	70.38
25	Warren Blinn, Rocky Ford	9,914	40.70	82.69

25	J. F. Crowl, Rocky Ford..	9,878	59.19	72.55
25	W. B. Brown, Manzanola........	9,111	——	——
25	R. J. Johnson, Rocky Ford......	9,000	——	——
25	M. Figurski, Grand Junction....	8.959	——	——
25	C. Johnson, Rocky Ford.........	8.821	41.70	78.00
25	A. F. Buck, Granada.............	8,425	59.10	55.28
25	J. W. Setters, Manzanola........	8,123	56.45	43.38
25	H. B. Wakefield, Grand Junction	6,992	——	——
10	A. Morine, Grand Junction.....	4,489	——	——

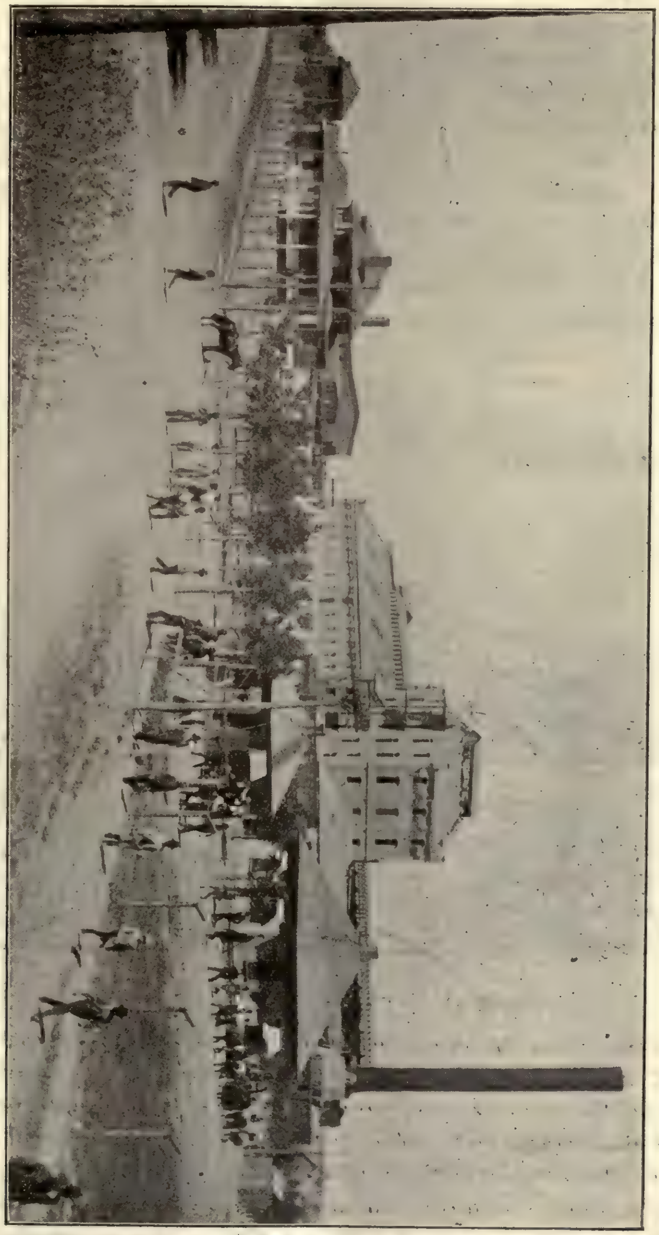
The largest yield of beets reported was 78,624 pounds, net weight of dressed beets grown on one acre, by D. V. Burrell of Rocky Ford, or a little more than 39 tons. This crop did not contain quite as high a percentage of sugar as some others.

WHERE THE BEETS ARE RECEIVED IN WAGONS AND BY RAIL.

The next largest gross yield was 74,396 pounds, net weight of dressed beets from one acre, raised by J. W. Bellew, also at Rocky Ford. These beets averaged 16 per cent. sugar, containing 11,963 pounds of sugar with a purity of over 82 per cent. This crop yielded nearly five tons of refined granulated sugar from one acre Mr. Bellew was paid $157.24 for the crop from his prize acre, the cost of raising it (including 6 per cent. interest on land worth $225 per acre) was $63.90, leaving a profit from the contest acre of $93.34. Mr. Bellew was awarded the grand prize of $200 in gold.

The average yield of prize winners in California last year in the *Orange Judd Farmer* contest was 21 tons of beets per acre; in Utah 20 tons, in Nebraska 13 tons, while Colorado harvested last year the marvelous average of 27 tons.

The individual experience of intelligent, practical farmers is always instructive. The writer has just received a statement from Mr. E. W. Manny, of Rocky Ford. which, covering a three year period,



A GENERAL VIEW OF THE SUGAR FACTORY

from the year previous to the construction of the beet sugar factory to the close of the second year of its operation, is especially valuable because it embraces so diversified an experience in the various lines

of farm gardening and presents so good an illustration of the progress of land values in the Rocky Ford region during the period named.

Mr. Manny, who is an old friend and boyhood school mate of the writer, is a college graduate as well as a practical, successful gardener, a close observer and a man of the utmost reliability. He says:

"January, 1899, I bought twenty acres of orchard of G. W. Swink for $150.00 per acre Oct. 1st, 1901, I secured a loan on the twenty acres of $150 an acre. The twenty acres had sixteen acres of apples, one acre of peaches, one-third of an acre of plums. The first year I came out about even. The second year I made about $700 over and above interest. The third year I made $1,200 clear. This was really off of fourteen acres. About six acres was uncultivated apple orchard, which set full, but the wind blew off all apples.

THE FACTORY FROM ANOTHER POINT OF VIEW.

"Apples have not paid anything. Peaches have not paid anything. Plums have paid about $200 per year off one-third acre. I have cut out thirteen acres of apples, so this year I will get in more beets. Had I taken out these trees last spring, I would have had $1,500 from the twenty acres, on the basis of this year's results.

"May 1, 1899, I bought ten acres of G. W. Swink for $115 per acre. Feb. 1, 1901, I secured a loan of $120 per acre on the 10 acres. In both cases the borrowed money was to pay the purchase price. (Loans made on a basis of 50 per cent. of actual value.) The first year

I came out even on the 10 acres. The second year I made about $800 on beets. The third year I made about $600 on beets.

One of the many Beet Dumps on the Santa Fe, Providing a Very Rapid Means of Unloading Into Cars for Transportation to the Rocky Ford Factory from Manzanola.

Oct. 1, 1901, I bought 20 acres of G. W. Swink for $150 per acre. Yesterday (Feb. 10th) I sold 5 acres of this for $200 per acre.

I have taken $80 off of one-third acre of table beets, $75 off of

one-third acre of tomatoes, $100 off of one-fourth acre in onions, lettuce, radishes, etc., $80 off of one acre of Lima beans. (These were a thin crop)."

All farmers are not as good managers as Mr. Manny, but many of his neighbors have done about as well.

KANSAS.

In Kansas the production of sugar beets is but just started. Under the provisions of the act of the Kansas State Legislature offering a bounty upon the production of sugar beets, however, this branch of farming promises to attain large proportions.

The following is the experience of Kansas farmers in the production and sale of sugar beets in the season of 1901, as reported for the State of Kansas by Miss Gertrude Coburn, daughter of Mr. F. D. Coburn, Secretary of the Kansas State Board of Agriculture, who has been investigating the sugar-beet industry in western Kansas for the purpose of deciding who were entitled to the bounty of $1 per ton offered by the State for all beets raised showing more than 12 per cent. of sugar.

WHAT WAS DONE IN KANSAS IN 1901.

Number of beet-growers	77
Number of acres harvested	337
Average acreage for each grower, acres	4 37
Total number of tons harvested	1,760
Average harvested by each grower, tons	22.82
Maximum acreage by one grower, acres	27
Minimum acreage by one grower, acres	.50
Maximum tonnage by one grower, tons	111
Minimum tonnage by on grower, tons	1.50
General average yield per acre, tons	5.22
Maximum yield per acre, tons	18.47
Minimum yield per acre, tons	1.15
General average per cent. of sugar	17.8
Maximum per cent. of sugar	22.8
Miuimum per cent. of sugar	13.3
Average cost per acre, given by 43 growers	$17.24
Mavimum cost reported per acre	31.00
Minimum cost reported per acre	5.00
Average price per ton received by grower (exclusive of bounty)	5.14
Maximum price per ton received by any grower (exclusive of bounty)	7.50
Minimum price per ton received by any grower	4.00
Average profit per acre computed from reports of 37 growers	17.08
Maximum profit per acre reported	43.00
Minimum profit per acre reported	.16

The following table contains the showing made by 15 of the most successful of the beet growers who have reported to date, but a com-

plete report would, it is believed, contain the names of others whose tonnage and profits would be even greater:

Grower.	Acres	Total Tons	Tons Per acre	Per Cent. Sugar	Profit Per acre
Carl Coerber	7.6	95.80	12.74	18	$43.00
M. D. Biehn	4.75	52.99	11.16	19.2	30.00
R. B. Glass	7.	65.78	9.40	18	21.00
G. A. Dodds	2.25	24.66	10.96	18.2	30.00
E. A. Smith	5	46.34	9.27	20.9	11.05
C. H. Wills	1.3	11.93	9.17	16.1	39.77
Nathan Fulmer	4.5	40.60	9.02	18,	22.22
W. A. Shively	8.	43.64	5.45	16.80	13.00
W. M. Sylvester	2	30.58	15.29	16	37.40
Holcomb Cattle Co	7.3	85.58	11.72	20.4	40.00
F. C. Pennington	1	9.40	9.40	14.6	30.30
Lee L. Doty	2	21.66	10.83	16.3	25.50
N. T. Viers	1	9.90	9.90	19.2	40.00
P. N. Meroney	1	7.18	7.18	16.4	15 00
J. L. Owens	1	7.95	7.95	16	11.95
Averages	3.75	36.93	9.96	17.61	$27.34

The foregoing statements of "profits per acre" is exclusive of the bounty paid by the state.

Secretary Coburn adds the following suggestions as to the possibilities of an acre of sugar-beets:

Each square foot producing one beet, an acre should yield 43,560 beets.

At an average weight of two pounds each the product would weigh over 43 tons.

With an average sugar content of 16 per cent. the factory would pay for these, at present prices, $5 per ton, or $215 per acre.

The cost of raising these should not, at a high estimate, exceed $35 per ton, leaving a profit of $180.

The foregoing possibilities might reasonably be called the probabilities confronting the average practical farm-gardener who engages in sugar-beet production in the region under consideration. Practically all of the sugar beets raised in Kansas last year were grown in the extreme western part of the state in the counties of Kearney, Finney, Hamilton, Gray and Ford, in the upper Arkansas River valley, The content of sugar averages fully as high as in the Colorado district, and experience thus far obtained indicates that both the soil and climate of this great valley are exceptionally well adapted to the production of sugar beets.

Prices of the best beet lands in the vicinity of Rocky Ford range from $150 to $250 per acre. The best bottom lands whereon the Kansas farmers grew their beets are worth, at present selling prices, from $10 to $25 per acre, while second bottom lands adjoining can be had at from $2.50 to $4 per acre, and the surrounding upland, being the finest quality of grazing land, at from $2 to $3 per acre. This condition affords a most favorable opportunity to settlers to engage in mixed farming, which is the most profitable line of agriculture on a safe basis, with the certainty of great profit from the rapid enhancement in the value of lands.

IRRIGATION IN FIELD AND GARDEN.

BY PROFESSOR E. J. WICKSON.

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DEVELOPMENT OF WATER IN DRY STREAM BEDS.

Development of water in dry stream beds is a frequent recourse where the bed is largely composed of sand, gravel, or rock debris of various kinds. In the arid region especially the visible stream is often only a fraction of the water moving along a stream bed, and when no water is in sight there is frequently considerable underflow during the dry season. On large streams water enough has been intercepted to supply large irrigation enterprises, and in many cases a small stream will yield a valuable farm supply.

The first thing is to determine by a prospect in the dry season whether an underflow exists when the surface flow has ceased. Select a point in the stream bed where it seems to be confined to a deep, narrow channel, as well as can be judged by the steep, rocky banks, and excavate a hole or well down to water and open out the bottom so as to obtain a water surface like that in a well. By observing this it can be determined whether a water pocket or an underground stream has been struck. In case of a stream the movement can be detected by the collection of light litter, etc., on the downstream side, or, in case of a considerable movement, the flow of the water can be detected by the action of the lighter sediment. If no movement can be detected, the effect of pumping from the hole will give an idea of the amount of water available by the length of time the hole will stand pumping.

Supposing the prospect is promising by the tests applied, the stoppage of underflow by a submerged dam is the next step. To construct this an excavation must be made across the stream bed to rock or hard clay on the banks, and must be carried down to bed rock or hardpan at the bottom of the channel. Ordinary precautions against caving of the sides of this wide trench must be taken according to the nature of the material found. The water must be temporarily dammed and forced to flow through a pipe or box. Then the closest possible contact must be secured by effecting a lodgment in impervious material at the sides and bottom, and the dam should be constructed of concrete rich in cement, the upstream face being well plastered with cement or with a coating of asphaltum if available. When the work has set well the temporary escape of the water may be stopped and the loose material replaced on both sides of the dam. The top of the dam usually rises sufficiently above the stream bed to hold back a certain depth of visible water (fig. 6), and to deliver it at a level where it

can be conveniently taken into a pipe or flume and carried to a ditch below, where firm ground is reached. Of course the water can often be taken out by an underground pipe from a low point in the dam, if the grade to the point of use is sharp enough.

Holding water by a submerged dam has advantages. It employs a subterranean reservoir and largely reduces loss by evaporation, which is so great in surface storage. It is also a reservoir presumably with tight sides, else the prospect would not have shown sufficient water to impound. It is a safe dam, because it offers no resistance to freshets. If it lacks elevation for outflow, it serves as a fine cistern

FIG. 6.—Submerged dam in dry creek bed.

for pumping and conserves water for that purpose. A point of excellence in a submerged dam is its perfect bedding and construction so as to be water tight. This is not always attained, especially when the attempt is made to intercept a wide valley stream without definite banks, and some submerged dams are not as efficient as calculated upon. In work on a small scale it is not advised to try any experiment with such a source. For the farm supply the underground stream should be comparatively small and well confined on both sides.

DEVELOPMENT OF SPRINGS.

The opening up of springs is often a very satisfactory means of obtaining a farm supply of irrigation water. Their development sometimes consists in the excavation of a reservoir in a piece of springy or marshy ground, or in laying underdrains to take their flow and connecting them with a more convenient reservoir site at a distance. Sometimes a spring whose flow can not be recovered from the area of boggy ground below it can be opened up and its waters readily directed to a single channel, or to a pipe leading to a reservoir (figs 7 and 8). By this means waste land, which is both useless and treacherous, is

reclaimed and made productive, while at the same time the waste water which destroyed it is utilized to make other lands more productive. Many farms have blemishes of this kind to be removed, and long and costly channels are cut merely to provide an outflow to a

FIG. 7.—A bog hole caused by water from a spring.

water course. It would often be less expensive to include a system for irrigation, and thus to double the return for the necessary expenditure. Foul mud-holes, which are maintained for watering stock, can be made to yield a wholesome water supply for stock and an irrigation

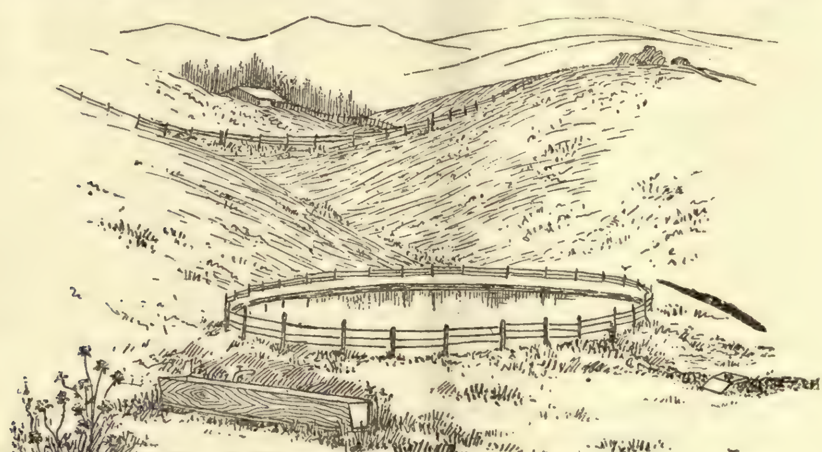


FIG. 8.--Bog hole made to yield clean water for stock and irrigation.

supply for the farm garden by piping from the reservoir, which can be constructed on the site of the old mud-hole at a little cost. All these improvements can be accomplished by the ordinary methods

and materials for underground drainage, and therefore need not be further discussed in this connection.

There is, however, one matter in connection with a projected utilization of a spring or any small outcropping of water to which careful attention should be given, and that is approximate knowledge of the amount of water which can be made available. This may be obtained before investment of labor or material is made, by opening up the spring thoroughly, cleaning it out to expose its outflow, and measuring the flow in a water-tight basin or a vessel of known capacity. Note the time required to fill the vessel and it can be quickly calculated how much the spring will yield in twenty-four hours. Almost every one will be surprised at the result of the measurement; a trickle of water thought to be too insignificant for consideration will be found to yield a very effective continuous flow if the water is collected. A five-gallon oil can is a handy measere. Suppose the spring fills it in two minutes, the yield would then be 3,600 gallons in twenty-four hours, or 108,000 gallons in one month, and this amount is equivalent to nearly four inches of rainfall on an acre of ground. Such an amount, if carefully collected and applied, would keep a garden of small fruits and vegetables in good growth, even with very little rainfall, if the soil be of fairly retentive character; as a safety supply against the short drouths of the humid region it would rescue a crop which might be worth several hundred dollars.

Thus a little outflow from a spring, which might pass away unnoticed unuerground, or at most by surface flow would only make a sedgy streak across a corner of a field, can be made a potent foctor in production. Of course, in handling water from such a small source of supply, it must be constantly protected from loss. It would disappear in an open ditch in a short time. Usually it must be conveyed in a pipe to a tank or tight reservoir and collected in sufficient volume to cover quite an area at each application.

COLLECTION OF WATER FROM SIDES OF CANYONS AND RAVINES.

In the same class with development of springs is the collection of water from banks in canons or ravines where floods have uncovered water-bearing strata. Water seeps out on these surfaces and sinks away in the debris which is usually found in such places, reaching at length the stream bed and passing away as surface flow or underflow, according to the character of the stream bed. Sometimes, where the difficulty of making the submerged dam is too great, the outcropping from the bank alone may yield as much as a good spring and be secured by cutting out a ditch at the bottom of the bank, cementing it or clay-bedding it well, or bedding in a plank box and connecting by a pipe with a reservoir, in the came way as in case of a spring.

To be continued.

VIEWS ON GOVERNMENT CONTROL,

By B. W. Rice, Ontario, Oregon.

Irrigation, as we have it at the present, is an art in its infancy. The irrigated districts of the western states, of which we are wont to make our proud boasts, are but mere daubs of clay upon the canvass. The meager systems of distributing water are essentially child's play. With but few notable exceptions, the irrigation canals of the western part of the United States are but travesties. The innumerable trifling canals which gird the foothills and pour their limited supply of water upon the valleys, are but so many indications of what the future has in store for us. So many children crying in the desert.

Irrigation is the systematic distribution of water throughout the land and the application of the same for the propagation of vegetation. As in all othor arts and sciences, mankind has started with irrigation on the experimental plane, have carried it along through this sphere, arriving at those results first which were the easiest attained and undertaking those projects which would yield to the least effort. As a result we now have the entire field of easy irrigation well covered, while it only remains necessary for combined efforts to carry into effect the principle on a larger scale and give the arid region a most thorough, practical and profitable system, and that system is the diverting from the larger rivers, at the proper points, a good part of the water which now rolls on to the sea.

So pressing is the need for additional irrigation facilities in the west that engineering parties are investigating hundreds of the proposed projects. Many of these schemes will, of course, fall by the wayside, for irrigation propositions are like mining schemes or lumber deals, the successes are often only on the blueprints. In nearly all of the arid states, and in many sections of each of them, the surveyor is endeavoring to hunt out places where water may be raised a little higher and taken a little further out on the land than ever before, while ahead of him and higher up lies the broad expanse of rich land that is certain to be covered later on by some gigantic system that he, in his limited scope, can hardly dare to contemplate. He realizes that all work on the systems less than the perfect one will ultimately be lost. He contrives to distribute the water before him to the best possible advantage, while on the heights above him he sees the inevitable, in a constant struggle, calling attention to that which he knows will have to be before the best is had, before the end is reached, and that is a great canal on the high plateaus further back. Everywhere the smaller streams are being carefully measured at the

different water supply periods and these measurements submitted under oath to those who are willing to finance a feasible canal. Careful surveys are being made of land that can be covered by the new ditches and where water supply, quantity and quality of land, marketing facilities and grafts on the community are reasonably certain, plants are installed, but few of which contemplate greater work than a score or so miles of ditch with a reservoir at the head.

There are only a few of the irrigation canals of the west now in the hands of the original owners. Litigation is one of the first diseases to which an irrigation canal is heir. After the smoke of the first battle has died away it is usually found that a reorganization is needed, and when this is perfected, if it ever is perfected, the original owners are out of the deal with more or less loss charges up to the speculation. This is almost the universal experience with a "stock" concern, and with the canal even owned for the people and by the people, it has been proven that the honesty of the people is graded by the distance they farm from the head of the ditch, it being an axiom that the only perfectly honest man on a canal is the one at the extreme lower end, where he has no opportunity to take water "out of turn."

The laws regulating or attempting to regulate the water feature of the arid west are in a most degraded, chaotic state, and this fact creates more litigation than all the mining fraternity ever dreamed of, and in fact lawsuits and family difficulties caused by loose laws on the subject are three times more than from theft, divorce, murder and the corruption of other property interests combined. The irrigation canal is often promoted for no other reason than the filching that may be done during the early stages of the proposition. The latter stages are never taken into consideration in fraudulent schemes for the reason that the promoters are well aware it is never to be carried out. The early work, the selling of worthless stock and other foul means are to give the opportunities for the "clean up," and after that the proposition falls by the wayside.

From all this it will be readily understood that an irrigation proposition is liable to be looked upon with a good deal of suspicion.

The mining world has been filled with so much that is dishonest, and this field of crookedness is so closely allied geographically with that of irrigation and other wildcat undertakings which, unfortunately, have been laid at the door of the westerner, while it, as often as not, was contrived in the east, that the capitalists shroud each new arid land proposition with the sensation of a joke. With the railroads, the armor plate business, the cattle and sheep industries, the stock markets, government bonds, etc., etc., furnishing the greater and more certain fields for investments, irrigation has been considered a secondary matter and one which should be approached with a good deal of

caution. The government, with its multitudinous ways of investigating, its numerous agencies for arriving at the depths of matters, and its ability to carry into effect anything that would benefit large numbers of its subjects, can do no better than to take decided action in reference to the continued appeals which are made from the arid west. It is clear, in this particular instance, that from no other quarter can more deserving appeals be made or more profitable expenditures be allowed. A number of different districts along the rivers of the west are sparsely reclaimed and sparingly inhabited, while with the water at hand, utilized judiciously, whole states could be made and towns and cities brought into creation and districts builded up equal to any of those now on the maps. Millions of acres of the richest soil may be reclaimed with an expenditure of $6 or $7 per acre, while the development incidental to the reclaiming of the land will bring into the general commonwealth outside influences of a greater value than the land itself. The utilization of water for power purposes, the building of mills and factories, the discovery of coal and other fuel, the finding of petroleum and other oils, the ever delving disposition of the miner into new fields and the uncovering of rare metals, the economic uses of range lands and the extending of railraad lines all go together to enrich a state when the land has once been reclaimed. Without the aid of the government the present undeveloped conditions will exist until sheer exhaustion of human existence elsewhere compels private enterprise to make room. This manner of reclaimiug the land will be fraught with hardships and privation. Crime will be encouraged and education will be neglected. With the long strides made by our government in anything it undertakes, the region will be thrown at once into the habitable, the pressure will be relieved in the older inhabited districts and a new world ushered in immediately, from whose people the general government will be able at once to levy taxes. The sale of the raw land under a governmental gigantic system of irrigation will put in the plant in ten years and restore the entire first outlay. These statements are known throughout the west to be true and we court investigation. There are a number of feasible propositions throughout the west where the government can take hold. The smaller of these require an expenditure of from $3,000,000 to $5,000,000, while those of greater magnitude call for a much larger sum, the greatest perhaps reaching the enormous figure of $50,000,000. With this money expended under the jurisdiction of competent men the west will have received an impetus of tremendous proportions, the like of which has rarely been the privilege of this government to bestow. The east will be benefited far beyond the surface calculation. The hydraulic pressure will everywhere be relieved and the throttled districts released. Ten million people will shift their place of resi-

dence and a hundred thousand homes can be reared on the relics of present failures. This subject deserves more than a passing thought. Nowhere in the realm of certainty is there a more deserving field for the writer or statesman. Nowhere is there less work for the politician. Everywhere throughout the west the voice of the people is being raised and everywhere in the network of valleys is heard the same plea. If the general government permits these appeals to go unheeded, let it be after the cause has been made known and the result surmised.

DITCH MAKING.

By John M. Irwin, Freeport, Ill.

The main ditch should be located along the highest level of land you wish to irrigate, so that the water may be kept up high enough to run into the latterals or small ditches, which in turn must be kept above the general level of the land over which the water is to flow. Should the bottom of main ditch or laterals be below the top level of the ground, then all the water in the ditches below the land level will be wasted, as far as getting it up over the land is concerned.

To put land in shape to irrigate, plow the land as deep as convenient, then with a drag made in the form of a capital letter A, but with the base 8 feet wide and the top 16 inches wide, as shown in diagram,  constructed as follows: With plank 2x6 inches and 12 feet long for side pieces and suitable plank for cross pieces to bind the outside pieces firmly together. The side pieces should be arranged on edge. When ready to go to work hitch to wide end of the frame, and after you have decided how wide and long to make the beds (lands), drive straight across the field from one side to the other; the wide spreading ends of the drag gather in the loose earth, clods and all, and heap it up back behind. This forms a ridge that will separate the field into beds. Some irrigators make these lands only 16 feet wide, while others make them two, four or more rods wide. The width will depend largely on the size of the reservoir. If the land is so large that it will require more water than the reservoir contains at one time it will not be all properly irrigated.

After the field has been laid off into lands or beds as described, then if the ground between the ridges is humpy or uneven a scraper will come into good play. The humps should be scraped into the low places, and after this is done a harrow or drag should be used, and to finish up with, a board leveler, well weighted down, should be dragged over the land to put the beds in perfect condition, so that the water

will spread evenly and flow rapidly over the ground so as to cover the entire bed. The ends of the beds should come up to the main ditch or a large lateral ditch, so that the water can be turned in full volume out of ditch on to the end of the bed. To do this, construct a dam (see how to make a dam in another paragraph,) about opposite the ridge which separates the bed to be watered from the next bed below it, and then cut the lower side of the wall of the ditch about the middle of the bed to be watered and allow the full volume of water in the ditch to flow out onto the end of the bed to be watered. The bottom of the ditch, as we have before said, should be above the level of the ground composing the bed.

The length of the beds will depend entirely on the lay of the ground and kind of soil. If comparatively level but sloping gently, 10 to 40 rods is a good length. The height of water in the reservoir above ground level, kind of soil and slope of the land all have certain effects, and no general rule will fit every case. It may be well to make short beds under one condition, while in certain cases beds may be made 80 rods long.

To irrigate such crops planted as potatoes, both Irish and sweet, and corn, they should be watered between the rows. To do this, a furrow should be run between the rows, beginning at the end of the land by the ditch, and only water enough turned on from the ditch to fill up the furrows.

Vegetables and all crops that are started by level cultivation (except field crops, such as wheat, barley, rye, oats and grasses,) should be watered in small areas, or over shorter distances, to avoid over or else insufficient watering. As soon as vegetables can be cultivated in rows then the water should be confined to the space between the rows when irrigating.

To turn the water on arrange the dam in the main ditch just below the point at which you wish to turn the water into the lateral, (the usual method is to construct a box with trap in main ditch just below the juncture of the latter with the main ditch, and also have the same kind of dam across the lateral a few feet from its juncture with the main ditch, so that the main ditch may be closed and the lateral opened, or *vice versa*), and then put in the dam across the lateral close by the ridge separating the land below from the one you wish to irrigate; then cut the embankment at the lateral on the side next to the land to irrigate.

Then open the waterbox of the reservoir by lifting the trap door just enough to allow as much water as you can use, without waste, to flow out into the main ditch. The water will flow rapidly along the main ditch until it reaches the lateral, and will then follow it to where you cut the bank and then will follow out and over the bed.

The evenness of the flow over the bed will determine how well you have done your leveling of the land.

If your reservoir supplies water enough for two or more beds at one time, irrigate only one bed at a time, and as soon as you have finished one bed remove the dam which closes your ditch and move along to the next ridge and put in new dam there and cut another opening through the lower side of the ditch embankment, closing up the opening first made and thus turn water off from the bed just irrigated, and onto the fresh bed to be watered and continue in this manner as long as the reservoir holds out.

Those who have had experience in irrigating say the best results are obtained by watering in the late evening, thus giving the water time to soak into the ground before the sun scalds the plant. For this reason practical irrigators prefer the evening for watering the growing crops.

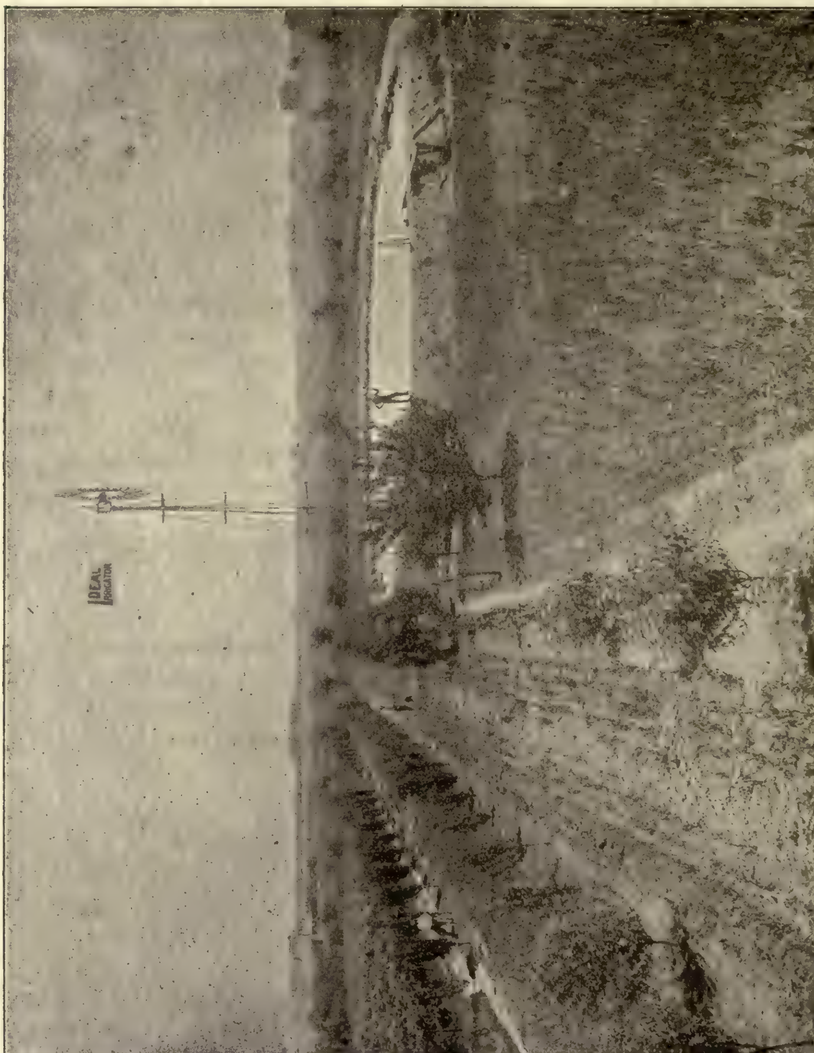
To make a canvas dam—first measure the width of the main ditch across the top of the embankments, for the length of scantling necessary to reach across; the scantling should be 4x4 lumber; then take the ducking cloth (old grain bags will do, by ripping them) a yard or so wide and fasten one edge of it to the scantling with carpet tacks or by nailing.

Place the bar of canvas dam across the embankment of the ditch where needed and take hold of the lower or loose side of the canvas and spread it across the ditch upstream. Then with a shovel throw a small amount of earth on the loose edges to hold it down, and if you have had no previous experience you will be surprised with the satisfactory results obtained with this dam. Its chief advantage, is the ease and quickness with which it may be changed from one place to another. It is a portable dam.

When the land is too sloping to water by allowing the water to run straight down the slope, in all land which slopes at sharp angle it will be best to so arrange the beds that the water will flow across the slope instead of down it. In this case the ditches must all be properly located and the beds worked down to as perfect a level as possible, and at the same time there should always be a gentle slope to the beds beginning at the ditch end and continuing through to the other end. This is obvious so that the water will flow readily the full length of the bed.

Uniform spread of water over the entire bed is the thing most desirable. To be able to do this requires that you have the necessary supply of water—a full reservoir to begin with—and your beds in good shape, with both main and lateral ditches properly made and in good order, with a sufficient flow of water out of reservoir into ditch. It is the pressure of water in the reservoir that pushes the water ahead,

and causes it to spread over all kinds of soils before it can soak away in the ground. For this reason the last half of the water in the reservoir is not as valuable as the first or upper half.



ORCHARD WINDMILL AND RESERVOIR.

To obtain the fullest results from wind mill and pump irrigation, such a full line of crops should be grown as will permit of all the year round work. Wheat and rye and alfalfa will require irrigation in the fall and winter; orchards also require watering in the winter. Lands intended for spring crops should be thoroughly watered in the winter; all kinds of spring crops, including corn and vegetables, require

watering in spring. Most vegetable crops require watering in summer; also the orchards should be watered for the last time in July. It is by general crop culture that Irrigation by wind mills and pumps is to be made most profitable.

The amount of land that can be irrigated, depends first, on the depth to water and supply of water in the wells; and second, on the size of wind mill and pump used. And when general crops are grown, so that the mill and pump may work the year around, larger acreage can be irrigated than when only truck farming is done. The same size wind mill and pump will irrigate only one-half as much land when water is raised 40 feet as when it is lifted only 20 feet, and only one-quarter as much land when the water is lifted 80 feet as when lifted 20 feet.

When low velocities of wind are to be used a smaller cylinder will have to be used, that the mill may be able to operate the pumps. A wind velocity below fifteen miles per hour furnishes so little power, with any size of wind mill, that few persons care to use pumps so small as to utilize the force of wind below fifteen miles per hour in irrigation. Substantial wind mills may be adjusted to work in a wind of thirty to thirty-five miles per hour, when the power of the wind is four to five times as great as when the velocity is only fifteen miles per hour.

How to utilize this varying force is of the greatest importance to those who use the wind to operate their pumping machinery.

An irrigating wind mill can make twice as many strokes of the pump in a 30 mile wind as it can in a 15 mile wind, and will consequently pump twice as much water, but as its power is more thon four times as great working in a 30-mile wind as it is in a 15-mile wind, it should not only have doubled its work, but should have quadrupled the amount done in the 15-mile wind. Hence it is readily seen that to utilize all the force of the wind up to the point the mill had been adjusted to govern at, two or more pumps must be employed, and as many pumps connected up, as mill can operate with the force supplied to the wind mill for the time being. A wind mill working under the full pressure of a 30-mile wind has power to lift eight to ten times as much water as when working under the force of a fifteen mile wind. To irrigate with wind mills and pumps implies that the time to pump is when the wind blows.

A complete wind mill and pump irrigating plant will consist of one wind mill and two or more pumps.

The reservoir should be constructed in an oblong form, *i. e.* 50x100 or 100x200, and so on. Then erect the wind mill near the embankment on one side, midway between the two ends; this will admit of operating one or more pumps on either side of the mill, by means

of quadrants, and the pumps be close enough to the embankment to discharge water into the reservoir through short flumes or pipes.

How much water, in addition to the rainfall, has not yet been fully determined for any kind of crops. Taking the generally accepted amount of 24 inches of rainfall as the necessary amount of water to mature a crop, it is only necessary to deduct the average annual rainfall frow 24 and the difference will be the amount to be supplied.

When the rainfall during the year equals 12 inches, then the 12 inches more must be supplied, and where the rainfall is 18 inches the remaining amount to be supplied is 6 inches and so on. One acre of ground requires about 27,000 gallons of water to cover it over one inch deep, and this amount multiplied by the number of inches necessary to add to the rain fall so as to make up the required 24 inches, will give the number of gallons per acre of water to be pumped, but due allowance must be made for leakage through the bottom and walls of reservoir; leakage and loss in ditches and evaporation, all of which amounts to a great deal in the aggregate. 250,000 to 325,000 gallons of water will probably mature one acre of any crops when the average rainfall is 12 inches or more. A pump with six inch cylinder will supply 1000 to 2000 gallons per hour when the wind velocity is 15 to 30 miles per hour and will probably supply water to irrigate 5 to 10 acres. A pump with 8 inch cylinder will supply 1800 to 3600 gallons per hour, wind 15 to 30 mile velocity, and will supply water to irrigate 20 to 40 acres of spring crops. When general crops are grown, so that the pump may work the year around, twice the amount of land can be irrigated. Smaller mills can operate pumps in shallow wells, while it will require mills of larger sizes to operate the pumps as the depth of well increases and the same mill will operate more than one pump, as the force of wind increases from 15 to 30 or 35 mile velocity, and the added pumps reinforcing the first one, increases the amount of water pumped so that a great deal more land can be irrigated than where only one pump is employed. Water supply and how to obtain it, is a problem but little understood. Open wells and well points are contending for preference.

Where the water is found in sand stratas of 12 feet or more in thickness, the drive well points have given best satisfaction. It is believed that even where the water is found in sand stratas four or five feet thick that the water will flow into the pump faster through sand points than through curbing into an open well—and then from the open well into the pump.

Much money and labor has been expended in the Arkansas Valley where the sand stratas in which the water is found, lies near the surface to make open wells that would supply sufficient water for large pumps, and while all attempts can not truthfully be said to have re-

sulted in failure, yet, sand points, large enough in diameter to equal one-half the diameter of cylinder used, have nearly always when driven down deep enough into the sand furnished abundance of water to supply the largest pumps when working at 25 to 35 strokes per minute. If an open well is to be made, a substantial curbing must be used and the well made large and deep, that the pressure will cause the water to flow in rapidly, and the large area give sufficient surface to supply enough water. The lower sections of curbing should be filled with small holes—very small to admit the water.

Where sand (drive well) points are used, an open well properly curbed should be made deep enough to reach down to water bearing sand, (in all sections where an abundant supply of water is found in strata of sand) and then the point or points should be pushed down until there is every reason to expect that the supply of water will feed the pump without exhausting the water from over the sand point for should the water be exhausted from over the sand point then the pump would be denied a full supply, for the same reason the point should be lodged in such water bearing sand or else the pumps will not be supplied, and injury may be done to the pumps, and the mill also may suffer injury, through the force necessary to create vacuum. Where several points are used to supply one cylinder, these are usually small enough in diameter that they may be driven, and even where one point is to supply the cylinder of small diameter, it may be driven, but large points should be put down, by first boring or drilling down into the sand, and casing to prevent the sand from caving in, then after the point is let down to proper depth and lodged in rich water bearing coarse sand, the casing should be removed by puddling it up and the sand permitted to fall in against the sand point. Enough suction pipe should be added to the sand point to bring the pipe up to top of water-bearing sand where the cylinder is to be located.

In all sections where the strata of water bearing sand is thin or too poorly supplied with water to afford a supply to the pump, a well should be made and properly curbed down to the bottom of the sand strata, and a hole bored or drilled down to second water, which usually supplies a sufficient quantity of water and which often rises up to the level of first water and sometimes even above it.

STORAGE OF WATER ON KING'S RIVER.

"Storage of Water on King's River, California," is the title of number 58 of the Water Supply and Irrigation Papers of the United States Geological Survey, now in press.

Kings River drains the western slope of the Sierra Nevada, in Fresno county, California, from Mount Whitney on the south to Mount Goddard on the north. Fully 80 per cent of the drainage basin is now included within the boundaries of the Sierra Forest reserve, a matter of prime importance to the irrigated lands below, for it means the conservation of the stream. The river debouches from its mountain drainage basin upon the plains of Fresno, Kings and Tulare counties, sometimes spoken of as the Kings River delta, which are near the geographic center of the state, and present great variety of climate and soil. Fresno and Hanford, the principal towns, are about 200 miles distant from San Francisco and Los Angeles.

Lumber, gold, copper, petroleum, grain, oranges, lemons, many varieties of deciduous fruits, grapes, raisins, wines and brandies are produced in this region in commercial quantities. There are more than 500,000 deciduous fruit trees in Fresno county. There are about 40,000 acres of vineyards. It is the great raisin district of California. The citrus belt, as is the case in southern California, is a narrow strip of land at the base of the mountains.

Irrigation is necessary for all varieties of agricultural products, grains possibly excepted. There are about 625 miles of main irrigation canals, covering 330,000 acres of land in the Kings River delta. A good water right adds about 50 dollars per acre to the value of valley lands, and about 90 dollars per acre to the so-called frostless foothill lands, where the citrus fruits, the most valuable crop, could be raised with an increase of the present supply of water, which has been diverted chiefly to the lower lands. The present combined capacity of the Kings River canals is stated to be approximately 4,000 feet per second. In September, 1898, the supply fell to about 145 cubic feet per second. During the last season the profits from the irrigated districts around Fresno were in excess of $2,000.000. Land without irrigation supply sells here for $10 per acre. The same land with a good water right sells for about $60. Hence the importance of the water power development considered in this report, which is on the Middle Fork of Kings River, above all diversions for irrigation or for storage. Kings River can be relied on, in spite of occasional seasons, for a great water supply, draining, as it does, 1,742 sqnare miles of area from banks of perpetual snow.

In the investigation of the Kings River basin a reconnoisance party, under Mr. E. G. Hamilton, topographer for the United States geological survey, reported upon reservoir sites, four of which were then surveyed by a party under Mr. E. H. Green. Of these four sites, Mr. Lippincott thinks that two should be utilized and that storage work should be begun by building the Clarks Valley reservoir with a 35-foot dam, and should be followed by the construction of a 140 foot dam at the Pine Flat site.

The Pine Flat site, on the main Kings River, five miles below Trimmer, just above the diversions of all irrigation canals, has an elevation of 600 feet, and the dam would cost $1,425,000. This reservoir could be used as a governor for filling the Clarks Valley reservoir, and then for holding the surplus water. Mr. Lippincott's conclusions are; That the observed flow of Kings River for the season of 1897-98 may be taken as a minimum; that these minimum years will probably occur about once in ten years; that there will be enough water during November to February inclusive to fiill every year the Pine Flat reservoir, with a capacity of 78,197 acre-feet; that in nine out of ten years there will be enough water to leave the Pine Flat reservoir full for use after July 1; that water that would be stored in the Pine Flat reservoir is water that would otherwise be lost; that the Pine Flat reservoir would irrigate the most valuable lands in Fresno and Tulare counties, now dry and unproductive; that the cost of storage would be $18.23 per acre-foot and the earning power of the reservoir fully double that amount.

The Clark Valley site is in Fresno county, sixteen miles east of Sanger, and has the stage road to Millwood and the arroyo of Wahtoke Creek through the center of it. The elevation of the base of the dam is 400 feet. It is proposed to fill this reservoir by a diversion canal 53,600 feet in length, with headworks above the mouth of Mill Creek and at the Pine Flat dam site. Two additional dams would be needed to block the valley completely up. The total cost, including supply canal, etc., would be $1,331,025; the total storage capacity would be 120,490 acre-feet of water, and the cost per acre-foot of water would be $11.05. Mr. Lippincott thinks that the Clarks Valley dam should eventually be raised to 105 feet with a storage capacity of 217,196 acre feet, and shows by a table that, with this larger dam, there would have been only one yoar out of eleven when both reservoirs could not have been filled.

The report then shows that the cheapest water supply in the valley can be obtained by pumpiug with electric power generated by the river itself before it reachss points of diversion or storage, provided the pumping plant is operated at least half the time A good location for the power house between the middle and the south forks, at an

elevation of 1980 feet, with an available head of 650 feet, was found by Mr. E. H. Green, who estimated the total cost of constructi on at $271,975, and the mean minimum horsepower produced at 7,336. The supply of water in the valley for pumping, based upon reports from over 800 existing wells, was investigated by Mr. Louis Mesmer, who concluded that 300,000 acre-feet could be obtained with certainty by pumping from the water plane or the Kings River delta. The transmission of power and the operation of the pumping plants was investigated by Mr. Lewis A. Hicks, who concludes that the annual pump output would be 328,500 acre-feet on the basis of use for 328½ days, at a cost of $10.50 per acre-foot produced.

By these means 200,000 additional acres of irrigated land could be added to the community.

Mr. F. H. Newell, hydrographer in charge, says in his letter of transmittal: "The situation on Kings River is to a certain extent typical of that along a number of important streams of the west, and as a result of this investigation it is believed that the reclaimable area can be greatly extended by the construction of storage works and also of power plants, by means of which, through electrical transmission, pumps can be operated at small expense out on broad valleys. The demonstration of these conditionn will prove one of the most important steps toward the transformation and utilization of the fertile but arid lands."

AGRICULTURE.

THE FARM WATER SUPPLY.

Every dry season emphasizes more clearly the importance of having a water supply on the farm that can be depended on in all seasons, at all times; and under all circumstances. A farm on which it is not possible to obtain a supply of this kind will never be a permanently profitable farm. Fortunately, water can be obtained almost anywhere in the Mississippi valley provided the farmers will go deep enough for it. Shallow wells can no longer be depended on.

The crops of the country over require more and more water every year, and the better the cultivation and the larger the crop, the more water it will require to make them. Every pound of the dry matter of the corn plant requires at least 275 pounds of water for its production; of oats, about 500 pounds of water; of clover and wheat, about 400 pounds of water, and other crops in about the same proportion. This large use of water by plants, together with the clenring away of forests, the natural drainage going on by the wearing down of water courses of all kinds, makes water more and more valuable every year and will compel farmers to go deeper with their wells before a permanent supply can be obtained.

It is not enough to have a permanent sapply of water in the well. The point is to arrange it in such a manner that animals can drink at will. It is not enough to allow live stock to have water once or even twice a day. If you will notice the habit of animals you will find that they drink water very frequently; for example, that at this time of the year when cattle are kept through on hay and forage alone, they will eat awhiie, then go to the tank and drink, then eat again, and so on through the day. The fattening steer will eat corn, go to the tank and sip, stand there and sip again, taking his time to the enjoyment of what, next to corn, is the greatest luxury of his existence.

The only satisfactory method of watering, therefore, is to have automatic distriburion. This on most farms can be easily secured and at a comparatively small expense; namely: by having a cistern on an elevation and automatic distribution through pipes to tanks properly regulated by floats, or else by a brick cistern built above the ground where the land is level when the same results can be secured. The cost of a system of this kind is from $200 upward, and no $200 is better expended than in providing for this regular water supply.

In many sections of the country windmills are available for raising the water from she well into the cistern. In other sections. where the wind cannot be depended on, the next best thing is the gasoline engine. We have had a windmill supplying water for from 300 to 500 stock during the winter season for a number of years. About all that has been necessary to water the stock was to see that the windmill was greased and the pump kept in order. At one time during last summer our water supply gave out through lack of wind, but this is the only time. Had it been in the winter season, when a large amount of stock had to be watored, we might have been in trouble.

Where winds cannot be depended on. the gasolene engine, mounted on trucks, is probably the best motive power for lifting water. By mounting it on trucks it can be used for sawing wood, grinding, and for other work as the windmill. Many farmers consider themselves especially favored if they have running springs which can be depended on the year around. While the possession of such a spring saves expense, nevertheless it is seldom as satisfactory or

convenient as the water system above described.

If any of our readers are short of water this year, or have cold fingers pumping in bad weather, we suggest that they lay their plans for an absolutely reliable supply, some machinery for pumping, and automatic distribution in the future. It is sometimes a very fortunate thing for a man that his well gives out or that his hired man leaves him, and he has to pump himself. It will be money in every man's pocket to provide such a system at any reasonable expense. It is one of the permanent improvements on the farm and will add to the selling value of the farm as much or more than the cost. We do not see how we could manage a farm without a never-failing supply of water and an absolutely reliable automatic system of distribution. —*Wallace's Farmer.*

THE QUESTION OF NATIONAL IRRIGATION.

In a recent issue *The Guide* printed a set of resolutions, which placed the New York State Fruit Growers' Association as against national irrigation for arid western lands. In printing those resolutions *The Guide* acted merely as a chronicler of the news, not as an advocate of the policy urged by the State Fruit Growers' Association. That the horticulturists of the Empire State should refuse to aid the Middle West in its demand for natianal irrigation strikes *The Guide* as a particularly precious specimen of "small potatoes." Many a time have the river and harbor interests of the east been helped by the votes of those who now ask the east's aid for a work that helps not only the west but the whole nation. For the economic future of the west works hand in glove with that of the east.

For unadulterated selfishness and narrowness of vision, the resolutions adopted by the State Fruit Growers' Association surpass anything that has come to the notice of *The Guide* for some time. By giving its "arable lands to anybody and everybody who will occupy them"—we quote the resolutions—the government has helped, under the homestead law, many of the Western States to acquire wealth and influence, has populated acres and acres of desert land with millions of thrifty and industrious people, and in lieu of placing a few millions in the treasury by the mere sale of these lands has, by giving them free, added immeasurably to the strength and prosperity of the nation as a nation.

What has been done in Colorado may well stand as a most potent argument for allowing the thirteen States involved in this proposed plan of irrigation to work out their own salvation in the way suggested. The plan to turn the melting snows of the Rocky Mountains into an agent for the producing of grains and fruits should receive the support of every man who has eyes to see beyond his nose, who has brains and heart enough to wish to see prosperity perch above other door-sills beyond his own.—*Fruitman's Guide.*

THE SUGAR WE CONSUME.

Statistics indicate that the United States consumes more sugar than any other nation, or approximately one-quarter of the whole of the world's product. The conditions of soil, climate and other advantages are quite as good in the United States, and especially in Colorado, Nebraska and Illinois, for the development of the beet as in any of the countries of Europe or Asia. The world's production and consumption of sugar is now about 8,250,000 tons per annum, two-thirds of which is produced from beet and only one-third from cane, whilst the normal consumption is estimated as increasing at the rate of 250,000 tons yearly.

Last year the United States consumed 2,220,000 tons of sugar. It will therefore be seen that we imported last year about 1,870,000 tons of sugar, most of which was

from beets. In other words, we still have to import six-sevenths of all the sugar we use. In the United States there was manufactured during the same time 270,000 tons of cane and 80,000 tons of beet sugar, which gives 350,000 tons as the aggregate product of the United States.

THE FORESTRY PROBLEM.

Nature prunes and saves; man cuts down and destroys. Some rather extraordinary work in the Adirondack woods emphasizes this truth. In theory it may sound well to say that only trees of a certain comparatively small diameter shall be left standing, but every woodsman knows that taking a piece of the original forest, if the large trees are cut down there will inevitably result injury to the smaller trees. It is too harsh treatment, and nature rarely uses harsh measures. The relation of the forest to the annual rainfall is important. It is found that cutting away the forests does not materially change the amount of the rainfall. What it does do is to do away with the capacity of the soil to hold back the water from the clouds, the forest soil having an increased amount of humas as compared with cleaned land, will hold more water. Especially on side hills where the roots of trees hold the soil, when they are removed the soil gradually wears away leaving only the bare rock incapable of holding any water.

It is a well-known fact that many of the smaller creeks, which before the country was cleared never were dry, are now dry for several months. The other result follows, that spring floods increase in volume. It was not the timber alone which was lost when the forests were cleared, but it was the loss in the capability of the land to produce farm crops.

Let the land or any part of it be reforested and this loss will, in a measure, disappear.—*The Grape Belt.*

A GRECIAN INDUSTRY.

In his instructive correspondence from historic Mediterranean countries Wm. E. Curtis gives this picturesque account of Corinthian currant culture:

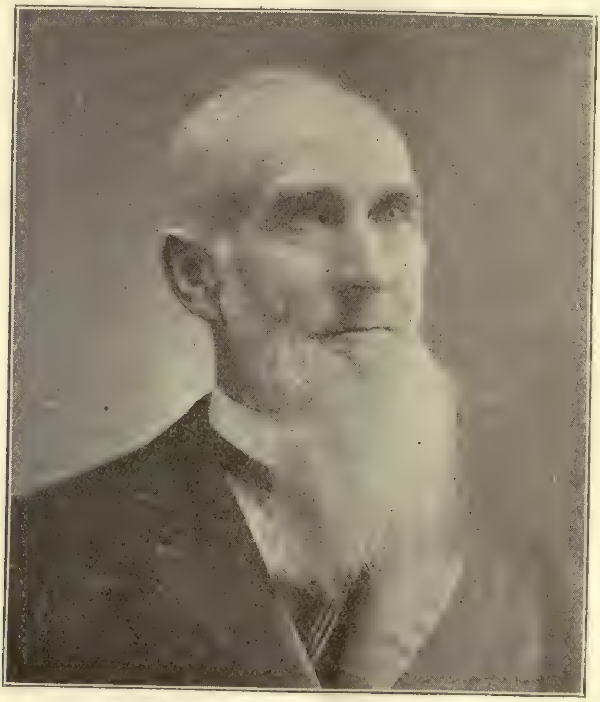
"From Patras to Corinth, along the edge of the gulf, through olive groves and currant plantations, with a range of snow-clad mountains on one side and picturesque hills on the other, is a delightful journey. The culture of currants seems to absorb the greatest degree of attention, and they tell me that the name of that toothsome little fruit was formerly correnth, and either gave a name to the city or took one from it. They raise currants differently down here from what we do, and chiefly by the labor of women. The earth between the rows is plowed with a pair of oxen and a crooked stick, and then the women of the neighborhood go in with hoes and heap the earth around the bushes, which are cut down to a single trunk every year. Around the base they dig a hole, which is filled with manure mixed with lime, to invigorate the roots, and then covered with soil heaped up, leaving ditches running at right angles, which are frequently filled with water from reservoirs that are centuries old. The water for irrigation comes from wells and is pumped up into the reservoir by a mule or a horse with a blanket tied over its head. The animal walks the endless and eternal circle and water pours out of a spout into a great cement cistern set into the ground at such an elevation as to give a natural flow into the fields. I did not see any windmill pumps or any other sort of arrangement. Every fellow has an irrigation system for himself.

"The new branches that shoot out from the trunks of the currant bushes in the spring are laden with fruit in the fall. It is the seedless currant, white and black, which you eat in plum pudding and mince pies and currant cake. The fruit is picked by the Greek girls, dried in the sun and shipped to all civilized countries. Currants are the largest product and the source of the greatest wealth in Greece. A large proportion of them are used in France for doctoring wines. I don't know how it is done, but the Greeks say that French wine owes its best flavor to their currants."

AN EASTERN CHAMPION.

Readers of the Irrigation Age will be glad to become better acquainted with S.S. Crissey, the veteran horticultural editor of *The Grape Belt*, of Dunkirk, N. Y., as he appears in the accompanying portrait.

Possessing all the sterling traits of good old New England character, Mr. Crissey must be accounted a potent factor in the educational movement for national irrigation, as he brings to his forceful editorial efforts the wisdom of long and active experience in the agricultural world.



S. S. CRISSEY.

Clear grit and unflinching purpose distinguish the aggresive educational campaign now being conducted by Mr. Crissey from his eastern position—a fair and fearless campaign of convincing logic that is breeding a larger patriotism in sections lately governed by prejudice.

If the East will reason in the light of Mr. Crissey's cogent philosophy, section lines will vanish and a needless discussion be averted.

IRRIGATION.

FOUR IRRIGATION QUESTIONS ANSWERED.

S. S. CRISSEY'S VIEWS.

1. Why doesn't the United States government leave irrigation with each state most directly interested?

2. Is the settlement and building up of any part of the west a benefit or injury to eastern manufactures?

3. Is it a benefit or injury to eastern agriculture?

4. Why did not the republican party in 1900 put an anti-irrigation plank in their platform?

1. To a certain extent national rather than state control is desirable, for the reason that, left entirely with the states, there might arise a diversity and possibly a clash of interests.

To illustrate, take California and Nevada. The eastern part of California is mountainous and not available for irrigation. The springs and streams could, however, be dammed up to irrigate Nevada. Or in other words, Nevada is to be benefitted by a water supply from California. Conditions of like nature exist between other states.

2. To ask this question is to answer it. Cotton cloth, boots and shoes, a hundred and one necessities of the farmer out west are the product of eastern looms and factories. The larger the market the larger the demand, and the more prosperous the manufacturing interests.

3. This alleged injury to farm interests of the East growing out of increased farm production in the West, is the strong point of anti-irrigation people. They say, "look at the prosperity of the west, look at the stupendous yield of wheat, corn, oats, etc. from their rich and almost boundless prairie lands, and then look at the falling off in price of our farm lands."

Our reply is that it is a case of wrong conclusions from wrong premises. A Massachusetts, Vermont or New Hampshire side-hill farm (and they nearly all stand more or less on edge), is comparatively valueless because of soil exhaustion. Put the fault where it belongs. Stripped of the original protecting forest, the rigors of a New England climate, combined with that kind of farming which forever takes away more than it puts back, has wrought the logical result of soil poverty.

But while, as a whole, New England and New York farms have gone back, eastern markets have gone forward. These enlarged markets call for more milk, more eggs, more fruit. If here in the past it don't pay as well as formerly to grow grain it pays far better to grow these specialties. Connecticut is fast becoming a noted peach-growing section, the near markets giving their peach orchards a great advantage over Georgia and California competition.

4. The Republican party in 1900 well knew that an anti-irrigation plank would lose them every state west of the Mississippi. The democratic party had a like streak of every-day common sense, not to mention patriotism and a just regard for the rights of all. Statesmen of all parties recognize that the irrigation problem involves land for an empire, or, better stated, land for a republic, within and a part of the Great Republic.

FREDONIA, N. Y., Feb., 1902.

A MOVEMENT IN THE NORTHWEST.

A recent letter from North Yakima, Washington, gives the following:

"The Northern Pacific Railway company has engaged in the business of constructing irrigation canals and will rebuild the old Kennewick ditch in eastern Yakima county. The canal is taken from the Yakima river and extends along the Columbia for forty miles, including an area of 30,000

acres of the finest land in the arid district of eastern Washington. Contractor E. C. Burlingame has a force of 150 men at work on the canal and expects to have it completed by June 1. The cost of this undertaking is $40,000, or about $1,000 per mile.

The land has not been put on the market and will not be ready for sale until the ditch is completed. It is understood that the company will divide the lands into ten and twenty-acre tracts and sell only to actual settlers who will build homes and locate at once. The price for land and water is reported to have been set at $25 an acre. No more than thirty acres will be sold to any one man, and that on the condition that the land is to be improved within a specified time. The element of speculation is to be completely eliminated, as none but home builders are wanted on the lands.

Kennewick was an important place a few years ago when the first irrigation canal was built by an eastern company. Many homes were constructed and thousands of acres of land homesteaded or purchased from the promoters. The great Columbia hotel, one of the finest in the northwest, was erected at a cost of probably $500,000, and everything went with a boom and whoop. The ditch company failed and everything was lost.

Town lots are selling at fabulous prices and a new boom has struck the place. Lumber yards and grocery stores are being established, and in a short time a complete transformation will be witnessed. Many tents are pitched on the grounds occupied by the town site. Saloon men are contomplating filing applications for licenses, and other places of business will soon be opened. The town is on the west side of the Columbia river, opposite the present railway division at Pasco. The nearest town is Prosser, but most of the supplies are purchased at North Yakima or Puget Sound cities"

WORK FOR IRRIGATION.

There never was a time when the needs of a national law governing irrigation was more thoroughly appreciated than at present. Prominent men who were opponents to the idea are now heartily in favor of it, and are enthusiastic workers to secure the passage of a bill to reclaim the arid lands of the west and also to provide against disastrous contingencies in the semi-arid sections where farming is now followed.

President Roosevelt is a stanch supporter of the idea, and in his first message recommended the early passage of a bill that would redeem the millions of acres in the west. This land must be settled in time. The rapid growth of urban population is a menace to the country, and can only be corrected by making other sections more desirable and attractive to prospective settlers.

The success with which small farmers have practiced irrigation has convinced the skeptics that the same system may be applied to arid land on a larger scale. We know of farmers who have produced enormous crops on lands in certain districts where the rainfall was less than two inches per annum. One farmer grew two crops of corn in one season and secured a yield of 13 bushels per acre; another grew Irish potatoes worth $250 per acre, and planted sweet potatoes on the same land the same season, realizing $275, or a total of $525 per acre in one year. This land, prior to irrigation, would produce nothing but scrub mesquite bushes and cactus. This statement is not exaggerated in the least. It is on record.

Several bills for securing government aid in this great project are now before congress. The idea is losing ground in that body, however, because of interest in other measures. A press dispatch from Washington states that the advocates of the rivers and harbors bill fear that they will not be able to secure the appropriation desired and are working to have the measure on

irrigation tabled. The irrigation men are working equally as hard; consequently a fight is on, with the odds against irrigation. Considering that appropriations are asked for the improvement and navigation of little creeks that are not even on the map, it would seem that the rivers and harbors bill might wait awhile, as irrigation is most needed.

President Roosevelt says that the government should construct and maintain reservoirs to preserve the flood waters of the streams, to be used when necessary for supplying moisture to the growing crops It is true that there are millions of acres that would never yield anything, even under the most favorable methods of irrigation, but there are even more acres that will yield bountifully and we must have them.—*Drovers' Journal.*

IRRIGATION IN THE UNITED STATES.

By Frederick Haynes Newell, Chief of Division of Hydrography of the United States Geological Survey. With 156 illustrations—maps, drawings and half-tones; 566 pages, with index, 12mo. $2 net (postage, 20 cents). Copies supplied by The Irrigation Age.

The era of fairy tales and wonder working is not yet past. The magician's wand which made oases in the desert is being grasped by the hands of that very vague but real personage we affectionately style "Uncle Sam," and he is urged to wield it vigorsusly over the arid plains of the far West. Already miracles have been wrought, and who can tell what further marvels await the magic touch?

Probably the average citizen of this country would be surprised to learn that two-fifths of our national territory is almost unknewn, and yet remains to be developed and made habitable. We have been so intent on legislating good harbors and waterways into existence, and in external territorial expansion, that we have not paid commensurate attention to the great problem of putting to use the vast resources of the West. Although a beginning has been made in the way of reclamation of the arid lands by irrigation, the greater part of the work remains to be done.

In line with this question, Mr. Newell's book is timely. He is one of the most capable writers of such a work in this country, his long official and practical experience giving him authority in his utterances. But he has not brought together the abundance of material here presented into a dry, technical treatise—the typical flavor of a government report. Instead, he has given a lucid, comprehensive and entertaining study of some five hundred pages, which commands attention from start to finish, and leaves the reader with a much better idea of a great problem than he could possibly get in the same length of time elsewhere. He has wrilten clearly and simply, avoiding technical terms, of the problems of home-making in the desert, showing what has been done in certain regions and what will e done in others. Home-seekers will thus find the work of the most immediate utility. They will be made acquainted with the amount and desirability of the public land, the natural resources of particular territories and the probable line of development to be pursued. A somewhat elementary and popular description of irrigation and of the devices for obtaining and distributing water is given, including details of interest to persons who are beginning to give attention to the subject. More space is devoted to the crude, but effective, home-made contrivances than to the elaborate or expensive machinery purchased from manufacturers, for the success of irrigation depends most largely upon the rough-and-ready ingenuity of the first settlers in a new country in adapting their ways to the environment.

Not alone to the home-seeker is this work valuable. One of the most moment

ous topics being discussed upon the floor of the present congress is irrigation, and noteworthy legislation is expected under that head. In his last message the President gave particular attention to this problem, strongly advising a national appropriatiou worthy of the need. He believes that Irrigation and Forestry are the two most vital internal problems of our country—and the two go hand in hand. The subject, therefore, becomes one of immediate interest to every intelligent citizen.

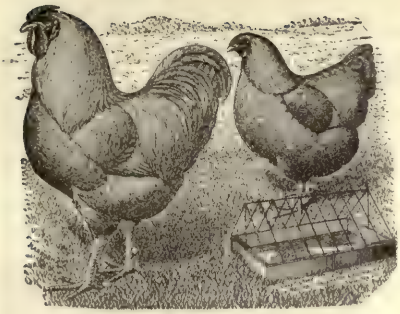
Dr. Newell's work will undoubtedly be taken as authority. It covers the topic adequately and accurately. The presence of many full-page illustrations, sketches and diagrams assist the reader, and lend both interest and beauty to an important volume.

A portrait of Dr. Newell appears as frontispiece of this number.

INFLUENCE OF WATER.

The waters of different localities vary much in quality and exert an influence upon the inhabitants of some places. Surface water in many localities contains carbonate of lime held in solution more or less by the amount of free carbonic acid present, making it more difficult of absorption than the organic phosphate of lime. Hard water is not the best for protracted use and is certainly detrimental to the health of those who have weak absorptive powers. Surface water containing any great quantity of sulphates is not good. Dentists have told me that they can almost tell where a person is born by the hardness of his teeth. Those who drink surface water full of sulphates are more likely to have brittle teeth than are those who have been fortunate enough to have used the water from springs or wells on hilly or mountainous districts.—*Dr. H. E. Peckham, in Hygienic Gazette.*

Irrigation has been quite active for the past month. Many who hoped that the liberal rains of early November would tide them over until next year have had to irrigate, although reluctant to do so. It is hardly likely that any more irrigation will be necessary before March or April or even later. The ground must be kept moist at this time of year because the dry, cold winds we usually have in place of rain are very trying on the trees when the sap is sluggish. Trees that are dry will, as a rule, suffer more from frost than those that are in a damp soil. The tender shoots, however, of the tree that has plenty of moisture may be nipped, but the general leaf system of a dry tree shows more marked effects from the cold. So it is in every way wise to irrigate whenever the soil is any way dry. The furrows may be left until danger from frost is past and water run whenever injurious cold is feared. The temperature of running water is generally higher than the atmosphere in a severe frost. For instance, on the morning of the 14th of December, with the temperature of the atmosphere at 28 degrees, the temperature of the water in the Riverside Water Company's canal was 58 degrees. This water going through an orchard in the early morning hours would have quite a mitigating effect. The moral of all this is if water is available in a cold time, irrigate, for a raise of temperature of two degrees means the difference between safety and loss. It must also be remembered that it takes more cold to freeze orange juice than pure water, as in like manner it takes more cold to freeze the salt water of the ocean than water that is fresh and pure. Again the riper the orange and the greater the percentage of sugar in the juice, the less it is affected by cold—*California Cultivator*



Golden Buff Wyandottes.

After eight years' continuous breeding, mating and perfecting this most popular and profitable variety, I have my yards free from disqualifying points, they are all Buff to the skin, and are from first prize winners of four of the best strains. The following is what Judge Theo. Hewes says of the Buff Wyandotte:

"I have no desire to boom this breed to the detriment of others, but I can surely give them a strong endorsement. After six years breeding them, I am free to say that I do not know of a single variety that would be a better investment for the amateur just starting, one who wants to handle one variety, and does not feel like taking up some of the older breeds where there is so much competition, than the Buff Wyandotte. Neither do I know of a variety that would make a better cross on common fowls to increase the egg yield."

My matings for 1902 are the best I ever had and will offer a limited number of settings of eggs after February 20th.

First yard, $2.00 for 13; $3.50 for 26.

Second yard, $1.50 for 13; $2.50 for 26.

Cash, P. O. or express order must accompany all orders.

For 25 cents I will send you a receipt for destroying all lice in poultry, pheasants, pigeons and dog houses. The druggist fills sample order for 10 cents. All you have to do is to tie bottle to nail in poultry-house, remove the cork and the fumes will do the rest.

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The publisher's price of this book is $2.00. We will send you the **Irrigation Age** for one year, and a copy of **"Feeds and Feeding,"** for **$2.50**. When you consider that the regular subscription price of the AGE is $1.00 per year you will realize what a bargain we offer you.

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the leading question is the replacing of worn out implements. If it's a ***Plow, Lister, Harrow, Cultivator,*** there is no question at all in the minds of many thousand farmers. It will be a

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of course, just as with Mr. R. F. Stockton, of Maywood, Ills., who says,

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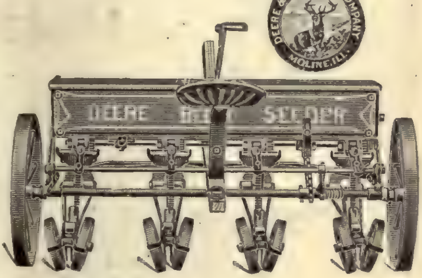
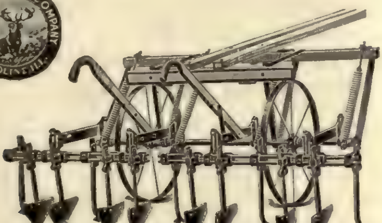
Has large seed box; wide tire carrying wheels; adjustable force-feed with positive drive; runner openers, either stagger covering wheels as shown in cut or concave as preferred. One lever raises all the runners and stops the seeding. The pressure spring insure uniform depth of planting. All adjustments are within easy reach of the driver and the dropping seed is plainly seen.





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Great Grazing Ground.

"Arid America," once the home of the Buffalo and Indian, has now become the pasture land of Agricultural America, whereon is raised the beef and mutton not only for American consumption, but for exportation abroad, in enormous quantities. Cattle and sheep, are born, raised, grazed and fattened upon the nutritious native grasses, and thence shipped direct to market. The profits are so great that new ranches are being started every day. Union Pacific lands are selling at the rate of 100,000 acres per month to men who are entering the business, or, who having made the start are devoting their profits to the enlargement of their operations. Write the undersigned, for an illustrated pamphlet containing a map and full information concerning

Profits in Sheep and Cattle.

S. A. McALLASTER, Land Commissioner. Dept. B., Omaha, Nebraska.

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...Potato Machinery...

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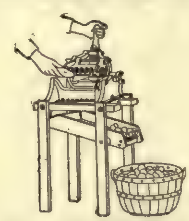

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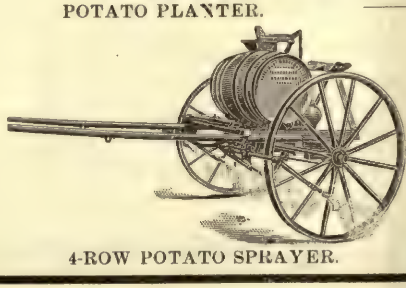

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A Friend of Irrigation.

THE IRRIGATION AGE.

VOL. XVII. CHICAGO, APRIL, 1902. NO. 4

THE IRRIGATION AGE.

D. H. ANDERSON PUBLISHING CO,
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A monthly illustrated magazine recognized throughout the world as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world, and has no rival in half a continent. It advocates the mineral development and the industrial growth of the West.

D. H. ANDERSON, - - Editor.

The Economy of Alfalfa. How many farmers have ever carefully estimated the saving of money and labor in a perennial crop as compared with grain or vegetables?

Even fruit and berries require special attention which reduces their proceeds. Irrigated alfalfa lands produce perpetually without attention and the average net annual profit per acre is rarely less than $10.

It will be seen that the revenue from 40 acres of alfalfa land, in full productive condition is more certain, regular and profitable than from any other crop, and that after the first year the item of preparatory cultivation is not only entirely eliminated, but the time and expense of this effort is always ready to apply in other directions.

Then, too, no tedious waiting for rain to come or go disturbs the desert haymaker. With his perfected system of water supply irrigation is practically instantaneous.

The farmer working 160 acres, 80 alfalfa, 80 other crops, makes a clear gain each spring of 50 per cent. in preparatory field work. He saves every year enough energy to put another 80 acres into alfalfa.

After the second year from planting alfalfa is a continual harvest and a complete satisfaction.

Could these facts be understood by factory employees, now slaving their lives away in cramped quarters at uncongenial and exhausting labor, we believe their savings would be quickly invested in the sun-kissed acres of the irrigated west.

Let us suppose a lathe worker has saved from his day's wages of $2.50 or less $700 or $800. With $400 he buys 40 acres of Wyoming or Arizona land with perpetual water rights; $200 will secure team and plow, and the other $100 will erect a tem-

porary shelter securing comfort in a region free from climatic hardships.

The unconventional life of the homemaker is no tax on his pocketbook, and in the first season he has plowed and planted his "40."

During the remainder of the season there will be ample time for the cultivation of garden supplies and for general improvements on the farm.

In the second season the first cutting of alfalfa is secured, and as three cuttings are possible in one season, which will aggregate at least 3 tons per acre and sell in the rick for from $8 to $10 per acre, it may be readily seen that the irrigated farm is a better money producer than the factory.

Railroads and Irrigation. We have nowhere found a better illustration of the recognized value of irrigation than in the celebrated controversy between the Oregon State Land Board and the two reclamation companies operating in the Upper Deschutes valley.

Without going into the merits of the case, which hinges upon the issuance of contracts by the State Land Board authorizing reclamation proceedings under the Carey arid land law to the Pilot Butte Development Co. and the Oregon Development Co., we will draw our lesson from the statement of President Lytle of the Columbia Southern, one of the most important railway projects of the upper coast country:

President Lytle said if the development companies should postpone the commencement of their contracts in the Deschutes country until next year it would be a serious matter for the proposed extension of the Columbia Southern, and might have the effect of carrying that over also. "One of the chief factors considered in deciding to push the railroad 100 miles farther into the interior of the state was the prospect of bringing large areas of arid land under cultivation.

"We must have all the development agencies possible at work in that valley in order to warrant the construction of the road now," said he. "The resources of that country are timber, mines and agriculture. But little development has been reached in those fields, but we are confident that, with the proper agencies at work, the country will soon yield tonnage that will make it worth while for a railroad to go there. We have counted a great deal on those reclamation enterprises to draw settlers and get the land to producing. I regret exceedingly that the matter is in such shape as it is, and I fear the effect of this delay will be disastrous."

Railroads and irrigation are interdependent, but irrigation must come first.

Montana Progress. With commendable forethought the recently organized Agricultural Association of Montana makes National Irrigation its battle cry, and proposes a vigorous campaign for the development of Montana's wonderful resources.

From the resolutions adopted by the association at Helena this stirring declaration of principles is noteworthy:

"Now we, the Montana State Agricultural Association, do hereby declare, 'The making of two blades of grass grow where but one grew before' to be the cardinal object of this organization.

"That we recognize the magnitude and possibilities of the agricultural resources of this great state, and that our life's endeavor shall be the promotion of irrigation, of home building, and of the turning of Montana's broad prairies and primeval forests into happy homes for the industrial masses of our state and nation.

"That it shall be our endeavor by the promotion of laws, both state and national, to turn the wage-earners of our land into freeholders, homebuilders and homeowners, thereby making room and profitable employment for untold thousands who prefer to remain in the ranks of labor; that we call upon our representatives in congress to use all honorable means in promotion of government irrigation as recommended by the National Irrigation Association and every enterprise calculated to multiply the agricultural industry of the arid west; that we oppose all measures of whatever kind and description looking to the leasing of the government domain."

The election of W. M. Wooldridge of

Hinsdale, president; John W. Pace of Helena, proprietor of *The Montana Stockman and Farmer*, secretary, and E. N. Brandagee assistant secretary and treasurer, and a board of trustees consisting of I. D. O'Donnell of Billings, J. M. Robinson of Boseman, C. C. Willis of Plains, C. H. Campbell of Great Falls and McClellan Wininger of Kalispell, assures the success of the organization in the work proposed.

The Indian Famine. In *The Quarterly Review* the immediate causes of the Indian famine are thoughtfully considered, and to the support of an argument favoring irrigation as the chief remedy calls into service several eminent authorities who present this pointed testimony:

"Irrigation," says Sir Arthur Cotton, "whenever it has been applied, proved a remedy, and no other ameliorative measure can compete with it. Sind, with the most deficient rainfall in India—averaging only fifteen inches—completely protects itself from famine by irrigation, whereas it is in districts with a rainfall of from fifteen to thirty inches that famines are most prevalent. The moral is that it is not lack of water, but lack of regulation and distribution, which is the cause of famine. The effect of the Godavari and Kistna canals, in 1876-'77, was so great that in one year of famine they produced crops valued at nearly twenty-five million dollars, or four times the whole capital outlay on the works.

"The benefits of irrigation are, first and foremost, insurance against famine. Irrigation works should be credited with the whole increase of production, not merely with the slight addition to the revenue from the water rate. The use of canal water allows valuable crops, such as sugarcane, rice, wheat, indigo to be cultivated instead of the less profitable millet and barley. The whole production, in time of famine, depends upon irrigation, since without it hardly an acre would come to maturity. It saves the lives of an incalculable number of human beings and animals, and prevents immense loss to the government from the direct cost of famine relief and from remissions of land revenue.

"The Indian government has, nevertheless, adopted a policy of starving irrigation in favor of railways. Yet even from the point of view of communication, canals proved more profitable. Even from the point of view of famine relief railways are of no great value, since they cannot carry all the food that is required; and they have the further bad effect of encouraging the cultivation of non-food crops, such as jute, for purposes of export, thus encroaching upon the area devoted to foodstuffs. Of course, this would be economically profitable if there were some means of importing food. But this is not so; and in a period in which the population increased 17 per cent. the export trade, which is the result of railways, has raised prices locally altogether out of proportion to the amount exported. Altogether, railways have had a bad effect for the small cultivator, the only profits going into the hands of great landholders and dealers in produce."

The reviewer points out, as another cause for the severity of recent famines, that "European competition has crushed out of existence local industries and increased the dependence on the land. The remedy for this is the encouragement of native industries. Reforestation is also necessary, the cutting down of forests aggravating the deficiency in the rainfall, while cattle manure, which should go to fertilize the land, is burned, owing to the lack of other fuel."

A Popular Nebraskan. Hon. Geo. P. Bemis of Omaha, Neb., is an enthusiastic supporter of the irrigation idea. On a recent business trip to Omaha it was our pleasure to become better acquainted with Mr. Bemis and to obtain some of his practical views on the importance of irrigation. Our readers will enjoy the short sketch on another page, coming as it does from one of the foremost citizens of Nebraska. Residents of Omaha have shown their high appreciation of the business judgment and executive ability of this public-spirited man by placing in his charge for four years the administration of their public affairs. His distinguished record as mayor and as one of the chief promotors of the famous trans-Mississippi exposition is a source of pride to the people of Omaha, but as a shrewd, successful leader in business and

politics, his fine human qualities have won for him more endearing and enduring distinction as one who, in a long and active business experience in the largest real estate operations, has never foreclosed a mortgage. Truly a unique and enviable record.

A Michigan Mistake. Among recent press dispatches we clipped the following reference to a failure which wouldn't have occurred in any section of the irrigated west:

"A report from St. Joseph, Mich., under date of March 8, says: 'The Wolverine sugar plant went out of business in Benton Harbor today. At the annual meeting of the stockholders today it was voted to sell the plant. In all probability the machinery will be moved away. Negotiations are now on with five or six different companies. Three years ago the sugar beet factory was organized and its capital of $200,000 was fully paid in. The company contracted for a factory costing $300,000 and the purpose was to carry this indebtedness until it could be paid for from the creation of a sinking fund. The first year the beet crop was very poor. The factory earned in bounty from the state $20,000, but this was lost, owing to the fact that the act was declared unconstitutional. The second crop of beets proved to be not much better than the former year and the farmers refused to replant the beets for a third crop.'"

The St. Joseph farmers should study irrigation instead of subsidies.

AN APRIL MORNING.

This morning when I woke I heard
The low, sweet chatter of a bird
Beside my window, where so long
I've missed the music of the song
That filled last summer with delight,
And saw a sudden, arrowy flight—
A flash of blue that soars and sings,
A bit of heaven itself on wings.

"The blue-bird has come back!" I cried,
And flung the window open wide.
I leaned across the mossy sill,
And heard the laughing little rill
That comes but once a year, and stays
Through the brief round of April days,
Then, when its banks with bloom are bright,
It seems to vanish in a night.

The old spring gladness filled the air,
I breathed it, felt it everywhere.
How blue the sky was! and a tint
Of color that was but a hint
Of "green things growing" greeted me
Along the willows by the lea,
And I could feel, and almost hear,
The quickened pulses of the year.

A warm south wind that seemed a draught
Of wine the sweetest ever quaffed
Blew round me, bringing balmy smells
That made me dream of pimpernels,
And arbutus blooms in pinewood nooks,
And gay wake-robins by the brooks,
And I was happy as the bird
Whose heart with spring's swift joy was stirred

—Eben R Rexford, in "Home and Flowers."

ADVANTAGES OF IRRIGATION AND OPPORTUNITIES FOR CAPITAL.

BY JAS. W. WILSON.

Farming by irrigation is the oldest, most scientific and successful method of tilling the soil. It began in the Garden of Eden, which was watered by the rivers which flowed out of it, and was the basis of agriculture in ancient Egypt, India and Assyria. It was also followed by the ancient Aztecs in New Mexico, Arizona and other countries inhabited by that remarkable extinct race, whose teeming population was fed by the products of irrigated fields. The Chinese are among the best irrigators in the world, producing a large yield from a small acreage. Without the larger and surer product which farming by irrigation supplies and insures China could not begin to feed her teeming millions. Also the most successful, all around small farm farmers in the United States are the Mormons, who farm exclusively by irrigation.

With control of the water supply and an ample quantity to use when needed crops are sure, and as it can be applied at the right time when most needed and in just the right quantity the yield is larger and the quality of the product improved. The farmer also does not have to hurry during the harvest, or concern himself for fear of damage by unseasonable rain. How often it happens that the fruits of a season's labor are damaged or lost through beating storms, rust, or wet spells during or following harvest, or in the season of hay-making. Also there are many occasions when it would be worth much to a farmer in any country if he could supply water artificially to his crops during a drouth.

This advantage is well illustrated by last year's experience in the central Mississippi and the Missouri valley states, where crops were materially reduced by drouth—an experience often duplicated.

Whereas in contrast at Greeley, Col., on the western edge of the great Missouri valley and on other irrigated farms, crops were abundant, wheat yielding 50 bushels per acre, alfalfa 5 tons, potatoes 200 to 300 bushels. The very misfortunes of the "providence farmers" resulting to the advantage of the irrigators in the greatly enhanced value of their products. Greeley potato patches proved veritable gold mines.

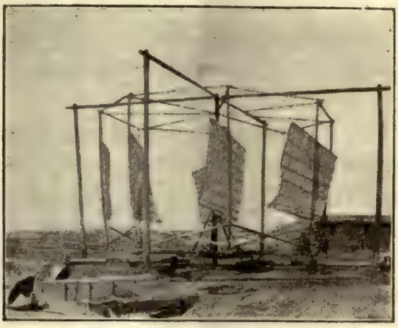
The Denver Post is authority for the statement that ex Gov. Eaton, who reclaimed a large area adjoining Greeley on the north and estab-

lished the town of Eaton, who rents his land for one-third the crop, realized a half-million dollars from his share of last year's product.

BETTER HEALTH.

The climate in irrigated countries is also more healthful, both for human kind and stock, because there is more sunshine and less exposure to storms and sudden changes of temperature and conditions of weather. The doctors uniformly recommend that those with weak lungs shall go to the arid regions. There being less humidity in the atmosphere, the "feel" of both heat and cold is less penetrating. The climate is also less favorable to the multiplication of man's greatest enemy, the bacteria germ. In many localities fresh meat when exposed, instead of quickly putrifying, as in the humid region, simply dries up, showing an absence of the germ agencies of death. There is also less of the larger insect life to destroy crops or annoy live stock.

It is also a relief, especially to nervous people, to be free from the fear of nerve-racking thunder-storms and the danger of cyclones and



Chinese Wind Pump for Irrigation.

violent winds, a condition characteristic of favored portions of the arid regions.

DEMAND FOR FARM PRODUCTS EXCEEDS SUPPLY.

Another marked advantage of farming by irrigation in the arid and semi-arid regions is found in the limited area available for tillage, consisting of a few fertile valleys, oases in the desert wastes of piled up rocks and mountains, while the demand for products at the adjacent mines greatly exceeds the supply.

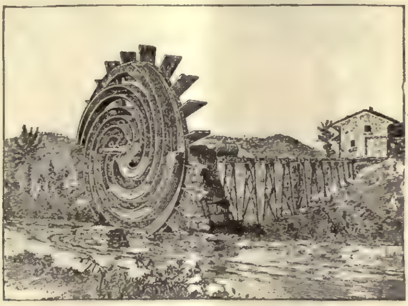
It so happens that the greater part of the food supply consumed in the western mountain regions is shipped from the plains of Kansas and Nebraska and other eastern states. For this reason exceptionally good home markets and higher prices for products abound, usually Kansas and Nebraska prices plus high freight charges and the cost of handling.

As the great resources of the west are developed, as is being done in leaps and bounds, as manufactories spring up and multiply as adjuncts to its varied wealth of mineral to turn out the finished product instead of raw material, as they are beginning to do, and other industries giving employment increase and arise, as they are certain to do, these agricultural oases will become veritable gold mines to their owners.

OPPORTUNITIES FOR CAPITAL.

These advantages so clearly manifest to the initiated are becoming knowu to the average farmer, and consequently the demand for irrigated lands now exceeds the supply.

It is the undoubted duty of Uncle Sam to construct canals, build reservoirs and apply water to the irrigable portions of the public domain. If he would do this and sell the water rights and land to them at cost, homes of their own and opportunity would be furnished to millions of his nephews and nieces, who must now, perforce, work



Irrigating in Greece with Tympanum.

rented farms, yielding the best part of the fruits of their labor to those who toil not nor spin.

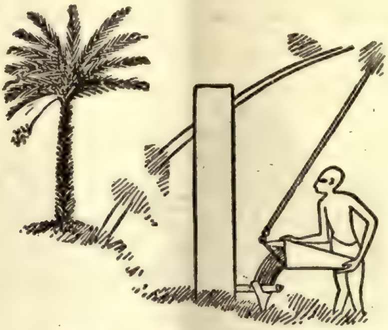
Also it would provide homes and opportunity for tens of thousands who are crowded out of occupations by the centralizing agency of trusts and monopolies.

It is not for us to criticise or mourn over spilled milk, but doubtless our blessed Uncle Sam was unwittingly drawn into it and, having caught the bear by the tail, is unable to let go; but if the millions which have been spent and will continue to be spent on the Philippines were devoted to reclaiming the arid and semi-arid public domain an empire would have been created worth a thousand times more to our own people each year than the whole archipelago will yield in a century. Our Uncle is in the Philippines, however, and is slow to appreciate the necessity of reclaiming his vast domain. It remains, therefore, for private capital to do what the public, as a whole, should undertake to do, and never was there a better opportunity.

CAUSES OF FAILURES.

There have been failures, many of them, so that in time past irrigation investments have been unpopular and irrigation bonds difficult to sell. Private capital is timid and naturally selfish, sometimes over-greedy for its own success. It is one of the vices of humanity to desire to sit at ease and in luxury while the other fellow toils and sweats. Formerly chattel slavery produced the toilers and sweaters, but higher civilization has abolished this cruder form. A more refined method is to get a cinch on the products of the toilers through the operation of stocks, bonds, interest and rents. It is much more satisfactory and more genteel to clip coupons than to own and farm "niggers."

One of the causes of dear water under so many irrigation systems and of the excessive entail of annual water rental fees, which is one of the chief causes of failure, is due to the operation of this process. Whether crops get sufficient water or otherwise the system is loaded



Irrigating in Ancient Egypt.

with watered stocks and long-term bonds, upon which it is expected the settler will shoulder the burden to pay perpetual dividends and interest.

The cause of most failures is traceable to this principle. The sensible settler is shy of shouldering such a formidable burden and is reluctant to yield the fruit of his toil to those who, while they may have advanced the money to establish the system, have received it back again with interest and profit in the price charged for water rights, and therefore have no just claim to a perpetual royalty derived from subsequent water rentals.

It is needless to say that if capital will be content with the profit which is its just due for its part in the development of such enterprises to be realized from the sale of water rights and will not, in addition, attempt to exact an annual rental—in other words, will exploit the irrigation enterprise as it would subdivide a body of land and sell it off to settlers, making the water rights perpetual and eventually turning the system over to the owners sf the water rights on the pub-

lic ownership plan, there need be no failure. On the contrary, no available field of investment offers such opportunities.

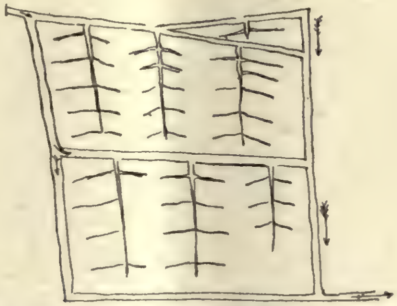
THE IDEAL IRRIGATION SYSTEM,

the kind which has proved successful above all others, which is now fostered by the laws of many states, is what is known as farmers' ditches. In other words, one that is owned by the community, the canals, reservoirs and water rights being the common property of those who use the water for irrigating the lands under them, with no entail or annual rental except the actual cost of maintenance, which, without the additional burden of providing interest on bonds and dividends on stocks is nominal, amounting to but a few cents on each acre.

A community thus established, with an abundant water supply, good lands, home markets and abundant and sure crops, such as every careful farmer can produce with irrigation, is sure to prosper, both individually and collectively. This is the class of irrigation systems and communuities capital will find its greatest profit in establishing.

EXAMPLES OF PROBABLE PROFITS.

There are some opportunities which will be expensive to develop, depending upon the character of the land and accessability of the



Spike System of Irrigating Meadowe in Spain.

water supply, and others comparatively inexpensive. The latter are not always the first undertaken, although naturally it is supposable they would be, because promoters and capital do not always know of their whereabouts, and the tendency is also to develop new systems in the vicinity of others where it has become the fashion to irrigate and where high values have been established. Engineers also like to undertake the hardest jobs, because it gives them opportunity for the display of skill and for profit.

Most of the very easy opportunities, such as a farmer or bunch of farmers can develop themselves on river and creek bottoms, where the water can be taken from the streams at no great distance from the land to be irrigated, have been taken. What is now needed is larger capital to reclaim extensive valleys or wide-spreading mesas or table

lands, to supply which water must be brought from a distance or stored in reservoirs.

There are many such opportunities which, as compared to the results, can be inexpensively developed, which are so favorable and promise such great profit that the wonder is they have not been before undertaken.

I have in mind one comprising 80,000 acres of choice land, well located, with a superabundant water supply, all cf which can be put

A Pear Tree in Fruit Under Irrigation.

under irrigation at an expense not to exceed $3 an acre, but which can be readily sold as fast as developed at $15 an acre. Capital should be content with such a profit as that without seeking a subsequent entail of rentals. In fact, $50,000 wisely spent would be all the money

capital need supply. If rightly managed the balance can be provided in cash and labor from the settlers.

I have in mind another which can be reclaimed at an expense of from a million to a million and a quarter dollars—a magnificent plain of rich, virgin soil, comprising 300,000 acres of the best grain, fruit, hay or vegetable land the country affords, adjacent to a city and good transportation, which would be well worth $30 an acre, with opportunities for building a city and promoting many industries.

Such opportunities are better than gold mines because they are sure, and creating wealth in this way is much more honorable than creating artificial wealth in organizing trusts and manipulating stocks or working corners on the board of trade. Creating wealth and opportunity in this way is exhibiting true patriotism, and is a work of humanity as well as of profit.

THE CO-OPERARIVE PLAN.

No matter how an irrigation system is financed it is the money of the settlers which must eventually pay for its canals, reservoirs, water rights and the distribution of water. The wisest and most economical plan for promoting such enterprises, therefore, if it could be brought about, at least for those most intimately concerned, would be to have the settlers combine, co-operate and build it themselves, those who are forehanded supplying the money to share in the profit resulting from sales on time payments to those who must buy in that way. Or a large part of the capital can be the labor of the settlers themselves expended in constructing the canals. In this way perpetual water rights can be very cheaply supplied, while avoiding the usual subsequent burdensome annnal water rentals, the subsequent expense being only the nominal cost of maintenance, which may be paid largely in labor. Under this plan irrigated farms can be supplied to settlers as cheaply as if Uncle Sam did the job himself, and with much less red tape. In fact, so cheaply and upon such easy terms as to be within the reach of all thrifty, industrious people.

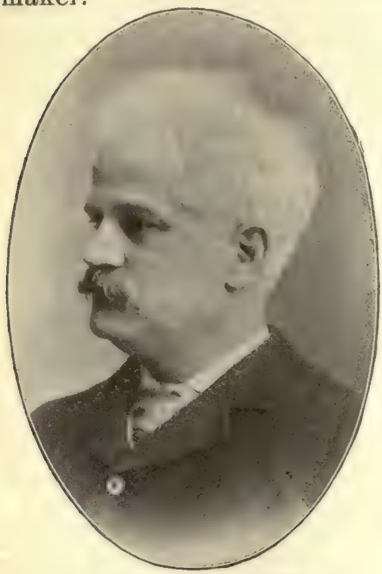
It is true it would be impractical to undertake large areas in this way, but there are many smaller ones which could be. For example, we know of a fine body of 15,000 acres of land, with reservoirs which nature has largely made, which could be reclaimed at an expense of $35,000 in money and labor, which it would be entirely practicable to develop on this plan. The land when reclaimed and in cultivation would be well worth $50 an acre. Those subscribing the money for such development could agree to deposit it with some trust company, to be used when the full amount of money has been subscribed, to be expended under the supervision of the trust company to insure its wise use, following the plan in this respect under which many Mexican plantation companies have been financed.

These are examples of many opportunities open to the investment of capital and to afford farms and homes to those seeking them. A boom is coming in irrigation, and those who catch it on the rise will reap the largest profits.

POINTS ON IRRIGATION.

GEORGE P. BEMIS.

A great many people these days are becoming quite interested in "Irrigation," and still comparatively few understand it. Naturally enough, being in the real estate business, we were frequently approached by people interested in a subject which, to say the least, is a wealth maker.



HON. GEO. P. BEMIS.

Now to answer the very many questions put to us, it was necessary to make irrigation a study, and the only way to study anything and be successful is to study it in a practical way; and to do that one must be right on the ground where the work is being done. So a few months ago we started out to visit some of the best irrigation systems in western Nebraska, Colorado and Wyoming, and many a valuable lesson we have learned.

People imagine that there is an enormous amount of work necessary to raise a crop by irrigation, as compared with the old way of depending on rain. We wish to say, dear readers, that no greater mistake was ever made. The writer, with many others, at one time labored under the same delusion, and while studying the working of one of the best irrigation plants in Wyoming intimated as much to the expert that was sent by the irrigation company to give us the full amount of instruction necessary to make a successful farmer on an irrigated farm, when to our surprise he deliberately took a side curtain from the buggy, threw it into the lateral, stood on one end to keep it on the bottom of the ditch, and then with both hands spread the top, one hand a little lower down stream than the other, he commenced to flood a field of oats. We simply make this statement to show how easy it is to put the water on the crop. Of course there are a great many appliances for handling the water; among them is a canvas, weighted, which is thrown into the lateral, causing it to overflow at any point

desired. Another mistake among beginners is the amount of water necessary to raise a crop. Corn, our king crop, only needs water twice. The first time when it is beginning to silk, the second and last time when the ear is ready to fill. A good plan is to thoroughly wet down the land in the fall; that, coupled with the rain, which every locality receives more or less, with the two final waterings will raise an immense crop of corn or small grain. Another advantage in raising corn is the fact that, if it looks like an early frost, all one has to do is to shut off the water and the corn commences to ripen immediately. We often hear it remarked among the farmers that the late rains will keep the corn green till frost, therefore the chance of corn being caught with the frost is very small when irrigated. Immense crops of potatoes are raised under irrigation, but the fault with the beginner is in putting on the water too soon; potatoes should never be watered till the little potatoes have started, or what is commonly called "set," for if watered sooner will grow nothing but vines.

Fruit—one of the luxuries as well as a necessity on a farm—is never grown better, with a nicer flavor and in greater abundance than when grown under irrigation. We have two orchards in mind, both in western Nebraska, one of forty acres, the other about thirty acres. Orchards with better fruit, more luscious and with larger crops surely would be hard to find.

Too much cannot be said in favor of irrigation; one great point is, in districts where it is necessary to irrigate, the atmosphere is very dry, therefore one does not lose a part of the crop, either in the shock or stack, through fall rains. Last fall in Wyoming, just before the wheat crop was brought to market, the elevator of a milling firm was burned, but that did not stop these parties from buying wheat; they simply put it in sacks and stacked it on a vacant lot; but in some districts it would have rotted by spring. We have a sample of that wheat which we are always pleased to show.

Time and space forbids us saying any more on this very interesting subject, but at any time we will be pleased to talk this matter over, especially with those who are interested.

GROWING WHEAT BY IRRIGATION AT GREELEY, COL.

By Jno. G. Hall.

Wheat will follow potatoes as a second staple production of this vicinity. Wheat is usually put in on the ground that has raised a crop of potatoes the previous year, which are dug in October. The ground is left smooth by the diggers that we use. About the middle of March the potato tops are raked and burned. Then the spring-tooth harrow is used to loosen the soil, so the seed may be covered. Then after the seed has been vibrated in sacks to kill the smut germs, it is drilled. The White Australian and the Defiance varieties are most commonly used. As soon as the wheat is about four inches high, or covers the ground nicely, irrigation commences. Open ditches are run lengthwise the field, about 100 feet apart, throwing a furrow both ways. The irrigation is done in lands, one land at a time until the field is finished. A second irrigation takes place in about ten days, which usually is sufficient, but some irrigate the third time if the weather be dry and hot. The most important time to irrigate wheat is when it is developing the head. After the kernel is full size it will not require more water, as there is moisture enough in the straw to carry it along until ripe. Wheat that is sown March 20 will ripen about July 25. Harvesting is done with self binders and headers, the major portion being cut with binders, as grain cut with headers and put immediately into stack does not keep altogether satisfactory. Thrashing is done by large separators with self feeders, and twenty horse power traction engines. The owners of machine hire all the help required and board the same by means of a boarding car mounted on wheels, which moves from job to job. Cost of thrashing runs about four cents per bushel for either wheat, oats or barley.

LITTLE THINGS.

A little spring had lost its way
  Among the grass and fern;
A passing stranger scooped a well
  Where weary men might turn,
He walled it in and hung with care
  A ladle at its brink—
He thought not of the deed he did,
  But judged that toil might drink.
He passed again, and lo! the well,
  By summers never dried,
And cooled ten thousand parched tongues
  And saved a life beside.—Selected.

WIND AND WATER

By John M. Irwin, Freeport, Ill.

PUMPING PLANTS.

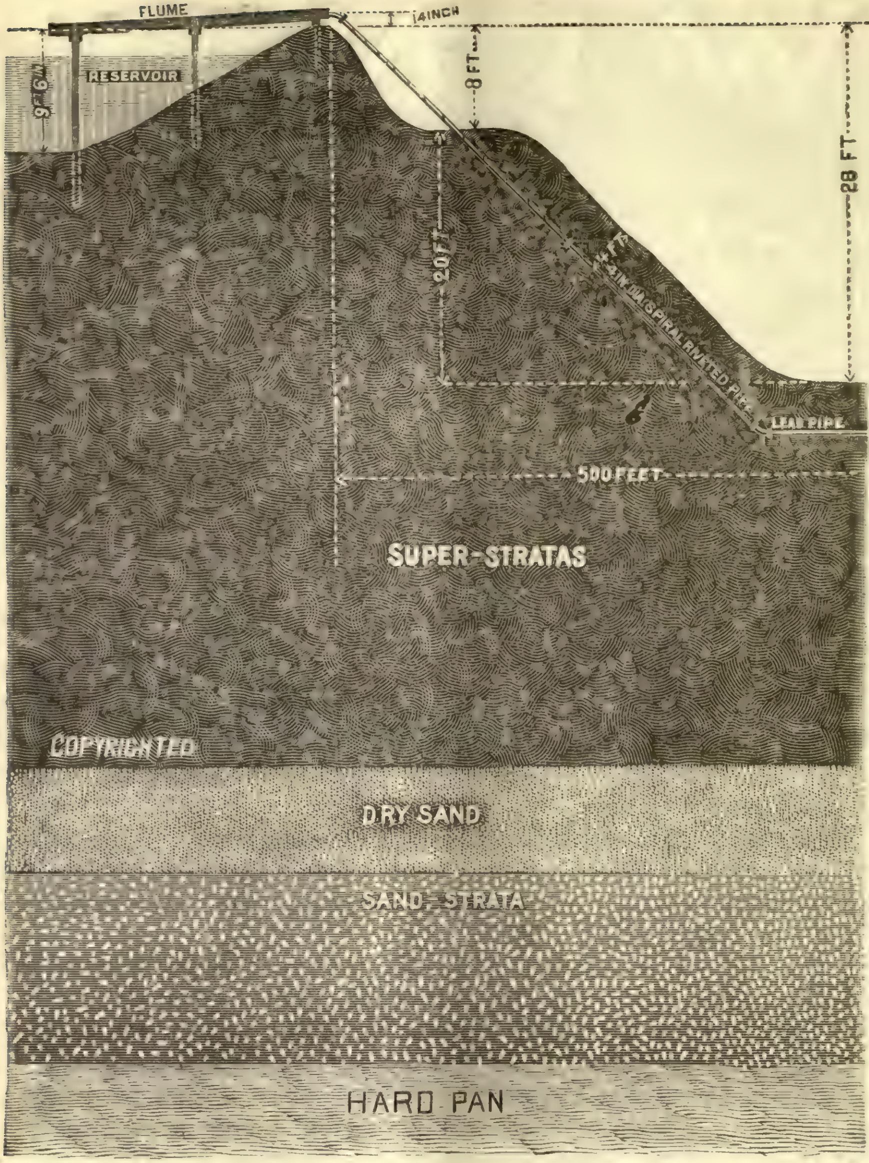
The installation of a complete pumping plant is not, as a rule, a difficult matter. The experience of practical men has developed a simple system that requires no expert to put in operation. There are exceptions to every general rule, and while it may seem expedient in some cases to deviate from the rules as established by the best practice, yet it will be best to adhere as closely as possible to the rules here given. Experiments are always uncertain until they are proved to be correct. Unless you have money to spare for experiments, do not make them.

Water is the first and most important consideration. Without an abundant supply of water for the pump there can be no successful pumping plant; therefore the well which supplies the water must be the best that can be made.

Wells, dug or bored, must be made deep and large enough to afford the required supply. Not all wells, however well made, will yield a sufficient supply, simply because the water bearing stratas are not always rich enough in water to supply a large amount. Shallow wells sometimes yield a very large supply, while others give only a small amount. Shallow wells sometimes yield a very large supply, while others yield only small quantities. Investigate the water supply before buying a wind mill or pump and then you can better determine what size to buy.

Open wells can be successfully made in clay and stone stratas, but as a rule are not successful where water is found in sand stratas

Screen points give better results where water is obtained from sand stratas. One large point will give better results than a number of small ones. Where a large quantity of water is to be used, and the



water bearing strata of sand is deep enough through it to permit of a greater length of screen point than is contained in one point, then two or more screen points, one above the other, should be used, unless the strata is composed of very coarse sand or gravel and yields a large supply of water; but where the water bearing sand strata is not deep enough through it to permit of such arrangement, then two or more points may be arranged independently of each other, and far enough

away from each other so that one will not rob the other, and then be connected to suction pipe below pump cylinder.

Screen points should never be less than two-thirds (⅔) the diameter of the cylinder. Screen points as large in diameter as the cylinder give still better results. The length of screen points to use will depend on the thickness of the water bearing sand strata. As a rule the coarsest sand and gravel is found at the very bottom of the water bearing strata, therefore the screen point should be put down to bottom of the water bearing strata.

Everything else being equal, screen points of large diameter will supply water faster than smaller ones, and when lodged at bottom of water bearing strata, in the coarser sand and gravel, will supply much more water than when lodged higher up in the strata, where there is less gravel and the sand is fine. In river bottoms, where the water bearing sand stratas are sometimes found to be 100 feet or more in thickness, it will not be necessary to put the screen point down to the bottom of the strata, but close attention must be given to coarseness of the sand or gravel in which the screen point is lodged.

Under no circumstances should the point be lodged in anything but the coarsest sand or gravel. Screen points not less than ten feet long should be used where there is enough coarse sand or gravel in the water bearing sand to permit doing so.

In every instance where a 10 foot screen point is used, and there is enough water bearing sand to permit it, the top screen point should be at least fifteen feet below water level. In water bearing sand stratas which are two shallow, that is, too thin to admit of points ten feet long being used, shorter ones should be used. In wells where the water bearing sand stratas are only a few feet thick, sand points must be only of such length as will insure the top of the screen to be entirely under water, so as to prevent air from finding its way into the pipe below cylinder. Large screen points are sold by the foot and can be bought in any length from two to ten feet long. It must be obvious that no more water can be pumped than the well affords. Therefore the necessity of limiting the size of the pump to the capacity of the well.

Open well making, where open wells can be successfully used, is so generally understood that only wells where screen points are to be used will be considered in this connection.

To put down screen points, make an open well large enough to afford room for two men to work in and sink it down to water bearing sand and curb it to prevent caving in. After this is done, it is more satisfactory to bore down through the water bearing strata so as to learn its thickness. A piece of gas pipe, of sufficient inside diameter to admit the use of a common auger, may be used for casing, and if

made in ten foot lengths and properly threaded at the ends to admit of extension by use of couplings, will enable the operator, by coupling on more pipe if necessary, to push his investigation to the bottom of the sand strata. A common auger may be used to bore the sand out of the pipe by using an extension to auger stem. The auger should be large enough in diameter to handle coarse gravel and even pebbles. This will enable the operator to determine the thickness of water

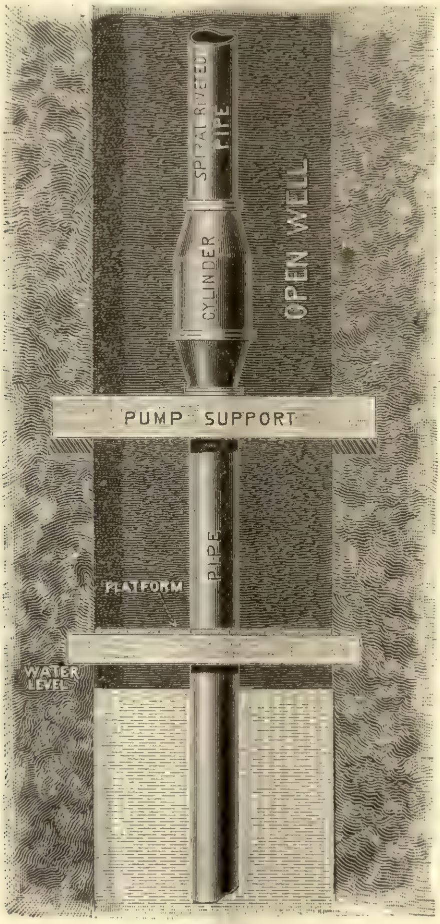


FIG. 1.

Fig. 1 shows an enlarged view of pump cylinder and pipe as arranged in an open well.

bearing strata, and besides, to determine the very location of the coarsest sand and gravel, and will also enable him to determine the length and diameter of screen point necessary to use, and the probable water supply that may be obtained from the well when finished.

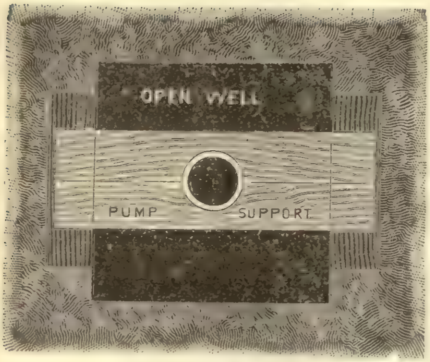
If the screen point to be used is four inches or larger in diameter

remove the plug (point) from lower end (all large screen points should be ordered with open ends) and place it in the proper location, being most careful to keep it in a perfectly perpendicular position, so that when it is sent down to the finish it will be exactly plumb. When it is thus placed in position, use a sand bucket to remove sand from inside. As the sand is being removed from the inside of screen point the operator will cause the screen point to be turned round and round, and when it reaches a point where its own weight does not suffice to settle it as fast as the sand is taken out, then employ the same method for driving it down that is used for driving small points, and drive only as fast as the sand is taken out from inside of screen. When the top of screen is well down to the bottom of open well, another screen point, when necessary, may be coupled on to the top of first one and the process of putting down continued as before. When all of the screen is down to bottom of open well then connect a length of heavy pipe for suction pipe, and continue to lower the screen point until it is down where it is intended to be lodged. As soon as the screen point is down into position then proceed to close up the lower end.

To close lower end of screen point take enough Portland cement to form a plug as thick as equals one-half the diameter of screen point. Example: For a screen point ten inches in diameter, use enough to make five inches thick. To put cement in place divide the quantity to be used in three equal parts, then put each equal part into a separate paper bag and tie a stout string or cord to top of one of the paper bags filled with the cement and let it down gently to bottom of screen point and with a jerk liberate the cement, and let down the remaining bags of cement in the same manner. The cement will set and become hard in the course of forty-eight hours.

Pumps for irrigation work to be operated by wind mills consist, 1st, of the cylinder or working barrel; 2nd, the pipe and strainer, or screen point, which is called suction pipe with strainer or suction pipe with screen point, and which conveys the water into the cylinder, and ground than where the mill stands. It will only be necessary in such cases to use the discharge pipe for a stand pipe, which can be extended up high enough in the tower to give the required head to force the water through the connecting pipe to reservoir, and thus do away with the very objectionable force pump head or standard, such as has been in use heretofore. The stand pipe may be continued on up in the tower to, or near, the platform at mill when necessary to obtain the head of water required to force it to and into the reservoir. When necessary to have a very high stand pipe, a tower of sufficient height to admit the use of the high stand pipe should be used.

The connecting pipe which is to carry the water from the stand pipe to the reservoir is called the lead pipe and should be large enough



FIF. 2.

Fig. 2 is a top view of the support for cylinder.

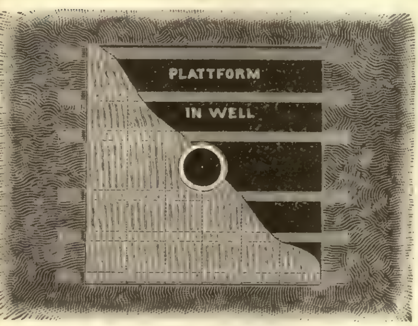


FIG. 3.

Fig. 3 is a top view of platform below cylinder and near the water. This platform makes a convenient arrangement when any repair is to be made to the cylinder.

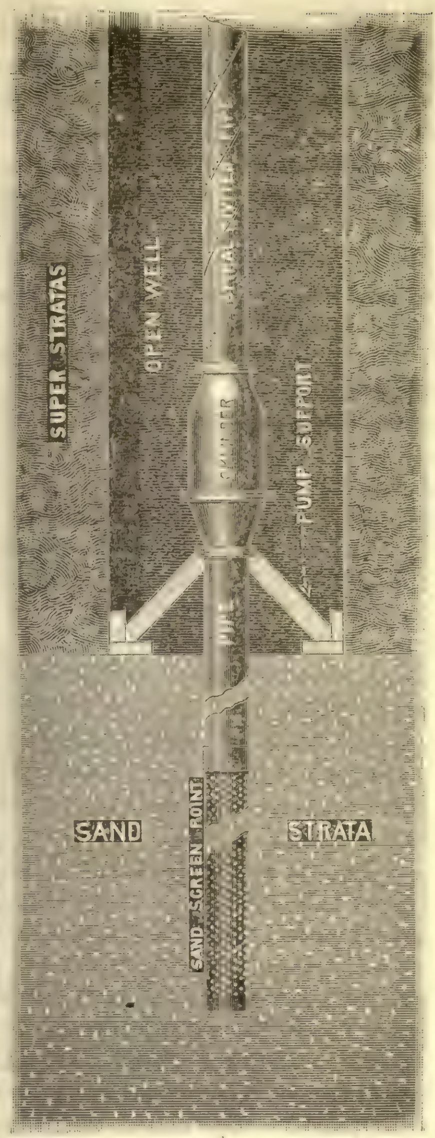


FIG. 4.

Fig. 4 shows side view of pump cylinder, as used with screen point, and the correct method of bracing same to prevent its settling and then getting out of proper relation with the working parts of pump.

3d, the pipe called discharge pipe, which conveys the water from the cylinder to point of delivery.

From the foregoing it will be seen that no pump standard so called is to be used.

Cylinders for irrigation work should have suitable valves of greatest possible capacity and be either brass or porcelain lined.

Suction pipe should be of standard wrought iron water pipe, not less than two-thirds ($\frac{2}{3}$) the diameter of the cylinder and always the same diameter as cylinder, when cylinders can be obtained properly fitted for such full size pipe.

Strainers. With pumps in open wells a strainer is used on lower end of suction pipe.

Screen points are used in all wells, with a few exceptions, where water is obtained in sand stratas, and should never be less than two-thirds ($\frac{2}{3}$) the diameter of cylinder, and always the same diameter when cylinders can be obtained properly fitted for such full size pipe; and should be of suitable length to afford an ample supply of water.

Discharge pipe for irrigation pumps should always be of same inside diameter as that of cylinder; so that plunger of pump may be removed for repairs or adjustment without the necessity of taking the pump out of the well.

Spout for outlet of water from discharge pipe should be near top of pipe.

Cap for discharge pipe. Take a board of two inch lumber and cut out a round disk, same size as inside diameter of pipe, then mortise a square hole in the center for draft rod of pump to pass through and fasten it in the top end of pipe, by means of nails or screws, having first punched holes in the pipe so that either can be used.

In open wells a substantial support, located within two to ten feet of the water, made of suitably strong timbers for the cylinder to rest on, should always be put in.

In wells where screen points are used, and the lower end of screen point does not rest on a strata of clay or other hard substance, it will be necessary to support the cylinder same as though in an open well, or else, as more or less sand is carried into the screen point with the water from below, the pump will continue to settle and the plunger work up into the pipe above cylinder and the pump get out of working order.

Support the discharge pipe by suitably bracing, so that it will stand in a perfectly plumb or perpendicular position; that the draft rod and plunger of pump will work most smoothly and with least friction.

It will often be found convenient to place mill near streams or other open water and force the water to a reservoir located on higher

inside diameter to carry all the water as fast as it is supplied to stand pipe by the pump, when doing its maximum work.

To connect lead pipe to stand pipe use a T, and connect near surface of the ground, so that when necessary to prevent freezing it may be buried under ground.

A reducer may then be used to connect the lead pipe of the required diameter.

To determine height of stand pipe required, find the height of elevation of the top of reservoir above ground level at mill and then use enough stand pipe so that it will be at least four feet higher than top of reservoir.

HOUSE AND HOME.

A house is built of bricks and stones, of sills and posts and piers;
But a home is built of loving deeds that stand a thousand years.
A house, though but a humble cot, within its walls may hold
A home of priceless beauty, rich in Love's eternal gold.

The men of earth build houses—halls and chambers, roofs and domes,
But the women of the earth—God knows!—the women build the home.
Eve could not stray from Paradise, for, oh, no matter where
Her gracious presence lit the way, lo! Paradise was there.

—Nixon Waterman.

A FISHERMAN IN HARNESS.

It's hard in this here country to get a feller's wish;
When the fields air right fer plowin', then he's wantin' for to fish!
From fur off field an' town,
Whilst the bees air buzzin' roun',
He hears the river callin'—sees the cork a-goin' down!

The soil can't be neglected, but it's purty hard to be
The head man in a furrow when the breeze is blowin' free:
An' in blossoms fallin' roun'
In medder, field an' town,
You hear the river callin'—see the cork a-goin' down!

—F. L. S in the Atlanta Constitution.

IRRIGATION IN FIELD AND GARDEN.

BY PROFESSOR E. J. WICKSON.

(Reprinted from Farmers' Bulletin No. 138, issued by U. S. Dept. of Agriculture.)

TUNNELING FOR WATER.

Tunneling to intercept water-bearing strata is frequently resorted to. Such tunnels have been aptly called "horizontal wells." In California thousands of them have been carried into hillsides to secure water for irrigation and for domestic uses, both in town and country. Outcropping of water at the bases of slopes, or at the mouths of depressions connecting hillsides, often suggests tunneling. The purpose is to cross the strata inclining toward the tunnel, and any available suggestion as to the dip of the strata in the hill, from seepage or otherwise, is important.

The writer knows of a case where several tunnels were run into a hillside at different points and none of them yielded in satisfactory amount, though carried several hundred feet into the side of the hill. Afterwards it was noticed that the base of the other side of the hill showed springs, while the side which had been tunneled showed none. The owner on one side lost all his investment in tunneling, while the owner on the other side secured all the water by merely opening springs, because the strata on the hill inclined his way. Tunneling is, therefore, not a sure way to get water, and some horizontal wells may be as dry as some vertical wells.

Again, there may be a quick rush of water into a tunnel which will drive out the workmen and almost as quickly cease. In such a case a sort of water-pocket or the upper part of a water stratum is pierced and its supply soon drawn off. And yet many tunnels are very satisfactory and enduring in their flow. One of considerable length is known to the writer, the mouth of which was walled up by the owner, an iron pipe and valve being securely bedded in cement mortar, and the tunnel made to constitute an underground reservoir as well as a source of supply, the water being drawn off as desired for domestic use and for garden irrigation. Drifting and timbering are involved in this line of water development, but they are not easily understood, and skilled workmen are necessary for such construction.

FLOWING WELLS.

Flowing wells are largely employed for irrigation in regions where such a supply can be secured. Their cost and availability are quite fully understood in those regions. It must be said, however, that

although constantly flowing water, at a proper elevation for distribution by gravity, would seem to be an ideal source of supply, it is not an unmixed blessing unless properly controlled. Proper control, by impounding in a reservoir or by capping the well so that its flow can be stopped when there is no immediate use for the water, is essential. In great enterprises the flow can be constantly used and the wells can gush unceasingly, but on the farm flowing water in excess of needs is apt to destroy much land. Again, a small flowing well, such as can be cheaply secured in some places, is apt to cease to flow in a time of protracted drouth, just when its flow is most desirable.

The behavior of this class of shallow flowing wells is shown by recent experience in parts of California in which there have been three successive years of deficient rainfall. There are belts where there has always been until this drouth a flow from small artesian wells, which are chiefly used for domestic and stock purposes; and, as the ground water was near the surface, the crops and trees were trusted to do their own pumping if they needed more moisture than rainfall afforded. During this drouth these wells ceased to flow, and the ground water sank too low for the shallow root system of the trees, and out of reach also of the roots of field crops. Alfalfa fields died out, not because the water was out of reach of alfalfa plants trained to seek their own supplies, but because the usually high ground water discouraged deep rooting, and the sinking of this water left the plants high and dry and dead. Hundreds of acres of rich land were bare and desolate, although the water stood but 7 to 10 feet below the surface. This seems almost incredible in view of what has been recently learned of cheap pumping. It was the freely expressed local opinion that these flowing wells had proved a curse. If the water had never flowed their owners would long ago have had recourse to pumping. If it had never flowed, there would not have been the increase of alkali due to surface flooding from such weels, with not volume enough to carry the alkali away below.

But while this is true, there are also flowing wells of great output and of enduring flow, which are rendering thousands of acres of arid land productive. Such full information on the subject of artesian wells, both those which flow and those which require pumping, is so easily available in the publications of the Department of Agriculture[1] that further discussion is not necessary here.

PUMPING FOR IRRIGATION.

Undoubtedly the most interesting and important phase of recent progress in irrigation practice is found in the use of the pump as a

[1]Notably in the Reports to Congress on the Artesian and Underflow Investigaions, 1892.

source of supply. Wonderful results have been achieved in increasing the efficiency of pumps and motors and reducing their cost of operation. Individual owners have often secured water by boring or digging wells and the use of a pump for much less than they could buy it from ditch companies, and thus are enabled to use more water and at more convenient times with less outlay. For this home supply all sorts of wells and all kinds of pumps and motors are being used, according to local conditions of subterranean water-bearing strata and local power supplies. The subject is too wide and varied for discussion in this place. It should be studied with the help of the best local well-borers and mechanical engineers and mechanics.

Several things are now very clear, viz.: That the capacity of all openings into underground water should be tested by pumping to determine what is the available supply; that, this being known, the motor and pump should be adapted to the supply by a competent expert and purchased under contract that they shall actually perform the service contemplated with the specified cost of fuel; that there is such great difference in efficiency and working cost between the modern pumping outfits and those of even a few years ago that one cannot afford to accept an old-style outfit even as a gift; that makeshifts of discarded thrashing engines and second hand pumps are too great an extravagance to be indulged in. These suggestions apply of course to all sources of pumped water, including wells, lakes and streams.

The development of pumping from local sources of supply has not only made individual farmers independent of distant supplies, but it has led to the organization of many neighborhood co-operative undertakings which are proving very satisfactory, and has led also to traveling pumping plants, on wheels and on flat boats. All such undertakings seem to be satisfactory when they are up to date in machinery and methods.

On many farms there are already wells with windmills and pumps for supplying water for stock, which can be utilized to raise a good garden of vegetables and small fruits, or to save a garden crop in a short season of drouth. Either the mill is shut down much of the time or the water is allowed to waste onto the ground around the watering trough. The only added investment necessary in order to use this waste is for a tank or reservoir to hold the waste water until enough has accumulated to be of use. The water from an ordinary pump will flow but a few feet from the well if allowed to run on the ground, but if it is collected in a tank or reservoir, and run out in a good-sized stream, it can be carried for a considerable distance, even in an open ditch, and much farther in a pipe or trough, and can be made to water quite an area of garden.

STORAGE OF STORM WATER.

A good supply of water for irrigation can sometimes be secured by collecting and storing the run-off during storms from lands lying higher than those to be watered. Such a source of supply is obviously less trustworthy in an arid than in a humid region, because of the smaller rainfall, the greater evaporation, and the length of time the impounded water must be exposed to loss from that source. Under such conditions reservoirs simply for storing storm waters are often not worth their cost. In regions having heavy summer showers it may be very different, because a comparatively short time may intervene between the falling of the water and the occasion for its use. Storm water is collected by damming a ravine or dry run which carries the water running off from the higher lands, and storing the water either in a reservoir formed by the dam or in a reservoir constructed out of the course of the stream to which the water is conducted through a ditch heading just above the dam.

The impounding of water by means of a dam across the mouth of a small ravine or canyon is often feasible, and quite a pond may be secured by a few days' work with plows and scrapers; or a swale through which the stream passes may be scooped out into a reservoir. In such work, however, one must know fully the character of the stream and the area of its watershed, and not undertake to restrain a stream of great flood power, though it be but rarely manifested. Such work has led to great injury to lands and improvements below.

Aside from such dangers, there are at least two objections to creating a reservoir in the bed of a stream. One is the chance of leakage; another is the rapid filling of the pond by the sediment carried by the flood water, thus decreasing the capacity of the reservoir. Stopping the mouths of ravines is open to both these objections, and is also disappointing, because in most cases much less storage capacity is secured than is expected, unless the dam be raised quite high, and this multiplies cost and danger with great rapidity. It is seldom desirable to enter upon such undertakings without competent engineering advice. For these and other reasons the reservoir for storm water, as for the gradual accumulation of a small flow, should in most cases be located out of the course of the stream.

Small reservoirs in connection with farm irrigation works are desirable from many points of view, and in making use of small runs of water are indispensable. A small stream allowed to flow constantly, no matter from what source, is of almost no use for irrigation, because it will not flow any distance when applied to the ground. But by saving the water in a tank or reservoir a strong stream can be made available for a short time, and will spread over a considerable area. The advantage and the cheapness with which such reservoirs can be secured need not be enlarged upon in this connection, for full attention has been paid to them in other publications of this series.[1]

[1]U. S. Dept. Agr., Farmers' Buls. 46 and 116, and Yearbook for 1896, p. 187.

To be continued.

IRRIGATION.

OVER-IRRIGATION INJURIOUS.

Too many inexperienced horticulturists depend on "water cultivation." The excessive use of water is injurious to the land. Arid land is naturally more fertile than where eqcessive rains fall, for the reason that copious and continuous rains leach the soil of the fertilizing elements. But if excessive irrigation is practiced, the same results will ultimately be reached. Many farmers are ruining their land by the "water cure." Moderate irrigation, followed by such cultivation as will make a "dust cover" and thus preserve the moisture and at the same time save the fertilizing elements, is much to be preferred. No soil can give up its fertility without moisture, but too much water will not only wash away its fertility, but will make the soil heavy, and in that condition it cannot give up the necessary plant food. After each irrigation have the soil thoroughly cultivated and pulverized. If this sort of work is done early in the spring, so as to conserve the winter moisture, then two irrigations, followed by thorough cultivation are all that are needed and are far better than a constant application of water without cultivation. "Irrigation and irritation" should go together. Some soils are absolutely damaged by the constant application of water, for they will cement and in this condition give up no plant food.

F. WALDEN, Zillah, Wash.

THE INDIAN SUGAR CROP.

The marvelous quantities of sugar that are made from sugar cane in that mysterious country, the far East, are occasionally heard from, but are really never fairly appreciated, as, like the American hay crop, which surpasses the cotton crop in value, it rarely ever enters into the markets of the world in competition with other sugar and hence attracts no attention. *The Louisiana Planter* has received Calcutta dates to Feb. 6, and the area in Bengal planted in sugar cane is reported at 843,000 acres, of which 812,000 were planted this year. The gross output of raw sugar in Bengal alone is estimated at 857,000 long tons, or about one long ton per acre.

While the Indian peasantry is the poorest in the world, hundreds of thousands of them dying at times of famine, yet they consume all of their sugar at home, seeming to thoroughly appreciate the great food value of sugar and molasses that we are only now beginning to learn.

DEEP WELLS AND CANALS.

The following table, showing the difference in cost and profit in rice growing by canals and deep wells, was prepared by J. A. Lambert, a well known authority:

DEEP WELLS.

300 acres irrigated by wells will produce 13 1-3 sacks per acre—4,000 sacks at $4	$16,000	
Expenses.		
120 sacks seed at $5 per sack		600
Interest at 8 per cent. on $7,500 land value		600
Cost of labor to cultivate and harvest, at $10 per acre		3,000
Threshing and sacking 4,000 sacks, at 20 cents per sack		800
Expense of irrigating at $3 per acre		900
Interest on well improvements ($2,000) at 8 per cent		160
Total		$ 6,060
Revenue	$16,000	
Expense	6,060	
Profits	$ 9,940	

Or $33.13 per acre.

CANALS.

300 acres irrigated by canals will produce 10 sacks per acre, 3,000 sacks at $4	$12,000

Expenses.

120 sacks seed at $5 per sack.....	600
Interest at 8 per cent. on $7,500 land value.....................	600
Cost of labor to cultivate and harvest, at $10 per acre..............	3,000
Threshing and sacking 3,000 sacks at 20 cents per sack.............	600
Expense of irrigating 300 acres, 2 sacks per acre, 600 sacks at $4..	2,400
Total..................................	$ 7,200

Revenue....................	$12,000
Expense....................	7,200
Profits....................	$ 4,800

Or about $16 per acre.

SHALL THE UNITED STATES LEASE ITS GRAZING LANDS?

The yioneers of all that widespread region could be called as witnesses regarding the former and present physical conditions and the destruction of its sole potentiality of wealth. Let one witness utter the testimony of all, whether they come from New Mexico, Arizona, Wyoming, Nevada, or any other state or territory in that domain.

Mr. Bayless, of Oracle, Arizona, in a letter to the Government agrostologists, says that the rich grasses of San Pedro valley are gone, and that the river channel is cut down from three to twenty feet. The valley is a sandy waste from bluff to bluff. Cutting down the river channel impairs or prevents its use for irrigation. These results are due to the use, free and in common, of the land for grazing. The average rainfall still comes, but nature's mode of conservation has been destroyed; and where, twelve years before, 40,000 cattle fed and fattened, 3,000 famine-smitten creatures now eke out an existence. Mr. Bayless adds that very few of these cattle were sold or removed from the range, most of them having been left until the pasture was destroyed, when they perished by starvation. The same story can be told of a vast majority of the four hundred million acres of grazing lands in the West, which belong to the Federal Government. Cattle have grazed below the point of sustenance for them, and sheep have followed to eat what remained to the roots and tramp the surface into dust. The agricultural settlers have their freeholds invaded by nomadic flocks and herds. Rival stockmen hold a portion of the range with winchesters. Homicides redden the struggle for survival, and a great industry is dying of starvation. The whole region has less water for irrigation, and yearly grows less inviting to the settler who seeks a home supported by that means. Is it not possible to end the struggle, to call back the forage, to stop the march of the desert, to restore the equilibrium of nature?

The Secretary of Agriculture, the hydrographers and agrostologists, and every thoughtful observer who lives in contact with these distressing conditions, are agreed in their suggestion of the means of restoration. They are not without a precedent to support their advice. The stock ranges of Australia, under the same physical conditions, had the same history. Nearly twenty years ago the Colonial Governments called the stockmen into council, and there was devised a leasing system protecting the rights of agricultural and pastoral freeholders and of large and small stock growers. Each one got a leasehold. He confined his stock to it, changed its grazing ground, and carefully nurtured the re-seeding of the forage, with the result that the carrying capacity of the Australian range is now restored to its virgin state.

Texas owns her own domain. A vast area of it is pastoral and arid. When used free and in common, the land became bleak and repellent, its forage being destroyed. A steer could barely live on a hundred acres. Less than a decade ago, against the opposition of the stockmen, Texas made a leasing law. Now an area of seventeen acres supports a steer. Tho range is restored, and a proposition to repeal the lease

statute would convulse the state.—*John P. Irish in the April Forum.*

IRRIGATING OHIO.

Whether the canals of Ohio are abandoned or not, the head waters and reservoirs should not be drained. They should be retained for irrigating purposes and be piped below and laterally for stock-watering purposes. Dams should be made across the other rivers of the state for irrigation and stock-watering uses.

With the denuding of the forests, Ohio is rapidly taking on arid characteristics. With the wise agricultural and horticultural methods of the future, the waters that fall from the clouds upon the bosom of our state will not be allowed to run away to the sea, but will be retained and used to more than double its food production, wealth and beauty.

Irrigation can be as profitably promoted by Congress in Ohio as it can be in the far West; indeed any one that is engaged in cultivating the soil knows that the lack of moisture is the greatest impediment to production.

Our Ohio soils should be made to produce twice the amount they now produce, and if you now multiply our present product by two or three, you will see we do not need to go to the Klondike for gold nor send our armies on foreign conquests for increase of trade.

Congress need not go to the western deserts to create soils when the naturally fertile soils of Ohio and other nearer states can be made to double or treble their production by conserving their moisture; and it can be done by far less expense than in the West; besides the retention of the moisture in this manner would greatly increase the annual rainfall, especially in the cropping season. JOHN BRYAN.

Yellow Springs, Ohio.

IRRIGATION IS COMING.

The irrigation bill has passed the Senate and it is believed that it will get through the House without serious opposition. President Roosevelt will surely sign it because it is one of his pet measures. This is one of the few bills in which there is no chance for politics to cut any figure. It has friends in every party or faction, and therefore ought to have easy sailing. The only opposition expected is from some of the Eastern Congressmen, who claim that its effects will be to depreciate the value of farm lands in the older states. That this contention is fallacious is evident. Its passage will probably have just the contrary effect. It will add millions of arable acres to the public domain, open up thousands of farms and homes for new settlers in the West and send back a stream of money to Eastern manufacturers for supplies. This will add to the wealth of the East, both in its industrial and farm life. —*Farm Machinery.*

Uneven channels in irrigation ditches retard the flow of water seriously, as do also water plants if allowed to grow.—*Orange Judd Farmer.*

IMPORTANCE OF IRRIGATION.

It is gratifying to observe a growing interest in irrigation, writes Mr. H. A. Crafts in *The Wisconsin Farmer.* The East has been slow to investigate the question, but for this it can hardly be blamed. So vast are our humid regions and so limitless have seemed the resources of their soil and climate that the idea of watering our arid plains by artificial means has appeared to the average mind to be almost an impertinence. But the very serious consequences following the drouth in the middle West have tended to awaken in the public mind some thought of future contingencies. They teach by what blind optimism our people have been providing for the present with no apparent thought of the future. But when we begin to support a policy of expansion by the argu

ment that we need more territory for the accommodation of our rising generations, and when a single season's drouth, sectional only in its extent, so seriously disturbs the normal supply of certain lines of food stuffs, it looks as if our economists should begin the study of the proper husbanding of our resources.

Recent history tells us of the direful famines in Russia and India. We read the harrowing details of starvation, of pestilence, of death. We pity, we give in charity, yet draw no material lesson from the carnival of famine. We attribute the sufferings of these people to ignorance and Pagan fatalism, and there let the matter rest. Does not our optimism almost amount to fatalism? Have we provided for the future by either laying in a store of surplus breadstuffs or providing means whereby we may stem the disaster of a possible wide-spread drouth?

The nation at large should understand that irrigation is not a sectional question. Who is able to compute the losses sustained by the farmers of Kansas, Missouri, Nebraska and other states of the Middle West by last summer's drouth? He who is able to do this should next exploit his mathematical genius in approximating the contingent loss to all other lines of business in those states and the added burden of the great consuming masses of the Union through the advance in the cost of the leading staples of popular consumption. Think how hard it must be through the days of grim winter for the poor to have this extra burden laid upon their shoulders; and how many young and craving appetites will go unsatisfied in consequence of the prevailing high cost of those two very important articles of food—corn and potatoes! Yet it is so hard to estimate the real extent of popular hardship until actual famine comes, because the great common people are so brave, so proud, so uncomplaining.

In the midst of all this untold distress, if not actual suffering, the Colorado farmers prosper as they have never prospered before. But I know that they are not unfeeling enough to congratulate themselves upon the indirect cause of their prosperity—the blighting drouth that burned up the substance of their eastern brethren. They can only rejoice that destiny guided their wandering footsteps to that part of the country where a system of irrigation stands between them and the destructive effects of periodic drouth. They did not escape the drouth, however, which only goes to prove more conclusively the inestimable value of irrigation as an agricultural expedient. Copious rains fell during the spring extending up to the last of May. Then they ceased, and there followed three months of hot, dry weather. No more rains that would any way affect growing crops fell until the middle of September. But thanks to the ample rainfall of the spring, crops of all kinds got a good start, and this fortunate circumstance, supplemented by an ample supply of irrigation water, brought about most surprising and gratifying results. Crops of all kinds produced remarkably. Some fields of wheat ran as high as sixty bushels to the acre. and other cereals proportionately. The potato crop—a crop of present and increasing importance—was a bounteous one, some fields yielding as high as 200 sacks to the acre, each sack holding 115 pounds. The hay crop, alfalfa, native and standard upland, was also large and was gathered in the very best possible condition, as a result of the continued hot and dry weather, and the hay stacks stand today all throughout the snow-clad fields, a living proof of the benefits of irrigation. Let us see what the Colorado farmer is getting today for the last season's products of his lands! Potatoes have brought all the way from $1.30 to $1.50 per hundred pounds by the car load lot, and have retailed in Fort Collins as high as $1.65 per hundred. Wheat sells at $1.25, barley at $1.30 and oats at $1.35 per hundrod pounds. Alfalfa, baled and delivered at the cars, has been selling for

$7, and other classes of hay from $10 to $15 per ton. Onions by the car load lot have sold at $1 per hundred and cabbages at 70 cents per hundred. In fact all the products of the garden, the orchard, the farm, the dairy, the apiary, the pasture and the range in Colorado find ready markets at good prices, and in some cases almost phenomenal ones. The consequence is that the farmer and all those lines of business dependent upon him are flourishing.

The effect is visible on all sides. Debts are being paid and mortgages are being lifted. Especially fortunate is the farmer who raised a good potato crop. Whole farms have been paid for by the sale of last season's potato crop; bank accounts are being swelled; improvements are being made on the ranches and more land purchased. Yet the consuming masses of Colorado, excepting in so far as the reflex of the general agricultural prosperity has an effect, are suffering in common with their fellow consumers of the country at large; so in spite of the beneficent influences of irrigation, the blighting effects of the drouth are felt here; which fact is only an added argument in favor of the nationalization of the system of irrigation.

Who then shall raise his voice against the utility, yea, the vital necessity of the system? If it is so beneficial in the arid regions, which are not by any means the main source of our food supplies, why should it not be of supreme benefit in those great regions upon which the nation, if not the world, depends for its bread and meat, in saving the crops in drouth years from partial, if not total, destruction? Supposing the vast millions that were lost in three states by last season's drouth were to be expended in irrigating canals and storage reservoirs in those states! Why, they would provide a system that would place those states beyond the danger of crop failure from drouth for all time to come! The topography and the water supply of those states are both favorable for irrigation. Consider for a moment the vast quantities of flood water that both rise and flow through those states year by year, only to cause damage on their way oceanward, and are yet lost forever to the vital uses of husbandry. These states, too, not only are well supplied with water within their own limits, but might have the advantage of those great waters of the north that annually come rolling down in turbid and irresistible floods, only to carry alarm and destruction in their path.

The storage reservoir is the thing. Irrigators of the arid regions are recognizing this fact. Irrigation water in the West is estimated to be worth all the way from 25 cents to $250 per acre foot, which means enough water to cover an acre of land a foot deep. This is the amount of water that the Colorado irrigator considers to be necessary each year to make a crop. Probably the lowest value of an acre foot of water as applied to land would be placed upon it when applied to native pasture; the highest when applied to land planted to small fruits. Its highest value is found in California for irrigating fruit lands. In Idaho it is estimated to be worth $50 for as common a crop as potatoes. The same is probably true of its average value in Colorado. Then how doubly valuable would it be in the great fertile valleys of the Missouri and Mississippi in a year of drouth such as that of last season! Water thus stored would be better than money in the bank, for it would pay a better interest, and there would not be so much danger of the storage reservoir bursting as there would be of the average bank.

Then, too, if irrigation were ever started in the East, promoters would find it much easier to prosecute their enterprises. Communities are more thickly settled, help and material are cheaper and money more plenty, and to be obtained at lower rates of interest than in the far West.

AGRICULTURE.

RACES OF CORN.

As our readers are thinking corn and talking corn this year as they never did before, we give them, from a report of the Kansas Experiment station, the following information as to the different races of corn, which we have no doubt they will read with interest:

There are five important races of corn grown in the United States on a commercial scale.

1. Dent Corn. A part of the starch in the grain is of a close, hard texture. This is called the horny endosperm, and is found along the sides of the kernel; while the softer portion or starchy endosperm, is found in the center extending to the summit. In drying the center shrinks more than the rest, and hence leaves a dent at the apex of the grain. Dent corns are the common field varieties grown in the corn belt and are almost the only kind exported. There are various colors, white, yellow and mottled (calico), being the most common. There are also red and blue varieties. Three hundred and twenty-three varieties are described.

2. Sweet Corn. This is chiefly found in the gardens, but it is grown on a commercial scale for canning purposes, and some of the larger sorts are grown for fodder. The first variety cultivated was obtained from the Indians, New England, in 1779. In 1854 there were ten varieties. Now there are sixty-three. Corn as a vegetable is practically unknown outside the United States.

3. Flint. The horny endosperm entirely surrounds the starchy, and hence the grain is smooth at maturity. Color various. Many varieties have eight rows and hence are known as eight-rowed corn. Flint corn can be grown much farther north than the dent corn, since it matures earlier, hence it is the prevailing form in Canada and the northern United States Since it is the common corn of New England it is often called Yankee corn.

4. Pop-corn. These resemble the flint corn, but differ in the ability to "pop" when heated. This phenomenon depends upon the fact that the starch is in the form of horny endosperm and the moisture present cannot easily escape, but finally explodes, turning the grain inside out. Pop-corn seems to be the least modified from the original type. There are twenty-five varieties.

5. Soft Corns. In these the starch is all in the form of starchy endosperm. It seems to have been common among the Indians of the southwest. Some of the blue Squaw corn belongs to this race. Brazilian flour corn, sold by seedsmen, is a soft corn. There is no dent in these varieties.

BUYING SEED CORN.

There are thousands of farmers in the country who will buy their seed corn this spring for the first time in many years. On account of the unusual demand, there will be much of an inferior quality sold at a very high price. Consequently farmers should exercise unusual care in selecting their seed.

In former years farmers have been able to select the largest and most perfect ears from their entire crop and have stored them for planting the following spring. A large number of these farmers were sufferers from the drought last summer and did not raise any perfect ears to speak of, therefore the man who has common corn of good quality may easily sell his surplus for planting at prices ranging from a dollar to a dollar and a half per bushel.

The shortage of seed corn among farmers is probably greatest in Kansas. The condition is serious enough in other corn-growing states, but is worse in the Sunflower state because the farmers have

practically no corn of the crop of 1900 to select from. In twenty-six counties in central Kansas nearly a half million bushels of seed corn will be needed. This amount will be increased should the winter wheat crop be injured to any great extent, as the acreage to corn will be larger than is now anticipated.

Much of the success of the 1902 corn crop depends on the seed. Farmers will be more painstaking than ever before in selecting seed, as good returns cannot be expected if an inferior quality is sown. In buying common corn of no distinct variety, as well as in buying the standard varieties from seed corn growers, some record-breaking prices are likely to be paid before the end of the planting season. —*Drovers' Journal.*

THE RETURN OF THE HORSE.

Secretary Wilson has given some interesting statistics on this subject. In 1868 the total number of horses in the country was 5,756,940. They were valued at $432,696,226. In 1892 the number had increased to 15,498,140, and the valuation to $1,007,500,636. In 1893 there were a million more horses in the country, but the value had declined, and this continued in number as well as in valuation until 1897, when there were 14,364,667 horses, with a value of $452,647,396, which showed a shrinkage in value of more than 50 per cent in five years. These were the years when the trolley car and the bicycle were crowding the horse, and his practical disappearance was predicted. But in 1898 the horse began to rally. The number of horses that year in the country was smaller than for any of the eight previous, but the value had increased to $478,362,407,

In 1899, while the number was pretty nearly the same, the value increased to $511,074,813, and in 1900, while the number of horses was about 200,000 less. the valuation advanced to $603,969,442. Secretary Wilson is among those who love the horse, and takes an optimistic view of the horse's future. "No horseman," he declares, "has ever lost his love for the horse. The man who loves an automobile is not the man who loves and breeds horses, so that gallant animal will be with us throughout the ages."

A LESSON FOR ROCKY FORD.

In the *American Agriculturist* prize sugar beet competition, there were three growers of Rocky Ford, Colo., each of whom raised over thirty-five tons of beets per acre.

This is not to be dismissed by the reader as "one of those newspaper big crop yields," because there are given the names, methods of cultivation, etc., all sworn to before a magistrate.

No grower in any other state reached the thirty-ton mark. Why should the growers of one single section so strikingly exceed all others? Up to a certain point all the competitors pursued the same plan of heavy manuring and intensive cultivation.

The Rocky Ford growers went a step farther and gave their beet fields the irrigation common to that famous district. The premium crop of over thirty-seven tons had the water turned on twice. It would have been irrigated once more but for the coming of rain.—*The Grape Belt.*

IMPORTANCE OF THE RICE INDUSTRY.

The coming rice crop in Louisiana and Texas will amount to about 3,000,000 sacks, and next year Texas will more than double her acreage, which should then yield fully 2,000,000 sacks in that state alone. Rice planting in Louisiana will also be on a more extended scale, the most of which will be along the river, as rice irrigated from the Mississippi is of much finer quality than that grown in the southwestern part of Louisiana and Texas. At present there are about thirty-five

mills operating in Louisiana, and about twenty new ones will soon be erected there and in Texas, the majority of which will be in the latter state, for the milling of the coming crop. The cultivation of rice in the Louisiana and Texas coast country has advanced land values from $1.00 in 1880 to $20.00 in 1901.—*Farm Machinery.*

THE CHINESE IN AMERICA.

We are pleasantly introduced to the curious Chinese and their peculiar customs by Sunyowe Pang who tells the readers of the January *Forum* a very entertaining story of the Chinese in America. As we are confronted with the Chinese question in an acute form Mr. Pang proceeds to inform us that:

"It is the general impression among Americans that the Chinese in this country are parsimonious. This is not the case. The Chinese have earned enormous amounts of money to be sure, but they have also spent largely. Their savings may be estimated as not more than ten per cent of what they earn, which is very often permanently invested in this country, and does not go to China. Laborers seldom save anything, and this is as true of the Chinese as of other nationalities. In the first place, the Chinaman is usually charged more for what he buys than any one else, and again he is inclined to be a spendthrift when he can. He is an epicure in his own way. He is also fond of silk clothes and expensive shoes. Very often he is a gambler. The actual needs of the Chinaman are greater in this country than in China. The climate in the Kwang-tung provinces is so mild that all he requires at home is a thin cotton blouse and trousers, and two extra garments for winter. His hat is of roughly plaited straw, and he wears straw sandals. In this country, he must wear woolen underclothing, a felt hat, and leather boots if a laborer. His boots in America cost four or five times as much as his whole outfit in China.

The food bought by the Chinese is often quite as expensive as that of the whites. Instead of living almost altogether on rice and chop sooy, as is the general impression, Chinamen, being quite as fond of meat as Americans, buy pork, beef and chickens. Chop sooy is made to sell to curious white persons who visit Chinatown. In the vicinity of every large city where there is any considerable Chinese colony there are truck gardens devoted to rasing vegetables exclusively from seed brought from their native land. These vegetables are unknown to Americans. But the Chinese also consume large quantities of the finer kinds of American vegetables. The Chinaman has a sweet tooth also; and in the best Chinese restuarants in San Francisco, New York, Chicago and other large cities, the best of wines are served to Chinese as well as American customers, together with the finest and most expensive foods. In the average Chinese restaurant in those cities good board can be had by the Chinese for from fifteen to twenty dollars a month, and these restaurants are largely patronized. As a rule, the Chinamen are compelled to lodge in mean quarters; but in New York and San Fransisco there are a number of well-appointed homes, occupied by the families of well-to-do Chinese merchants, which the American seldom or never sees. In New York there is an apartment house, up-to-date in every respect, occupied by Chinese families. The Chinaman sticks as closely as he can to the traditions and customs of his country, which are strange to the Occidental, and therefore, a subject for comment and often for derision.

There are not many rich Chinamen in America; but some of them are very well off, with fortunes ranging from $100,000 to $500,000. There is one multi-millionaire, Chin Tan Sun, who is the richest Chinaman in the country. Chin Tan Sun

owns whole towns, and employs hundreds of white men and women in his factories and canneries. He owns ranches, city real estate, gold mines and diamonds; he runs lottery games; he imports laborers; he conducts a real estate business; and he has several merchandise stores in San Francisco. He is a self made man and very shrewd and progressive. He came to America in the steerage as a lad, and went to work in a kitchen. He married a white woman, and with their savings they originated a 'little lottery' business in San Francisco. He was largely patronized by Americans, and soon grew rich enough to become a merchant also. From this beginning he developed into a commercial and political power. He is called 'Big Jim' on account of his size. He is six feet tall, and a well-proportioned, good-looking man. In business he is regarded as the soul of honor. His wardrobe is magnificent and several valets are needed to care for it."

WINDMILLS AND PROGRESS.

Under this head the United States Geological Survey sends out an interesting sketch. "In Holland," says this bulletin, "windmills are used to get rid of water; in America they are employed to produce it." Out on the great plains in Kansas, Dakota, Iowa and the adjoining states, an ideal place for windmills where the country lies flat and the winds sweep uninterrupted for miles, the landscape is fairly dotted with them. A number of the larger ones grind corn or do other similar work, but the majority are engaged in pumping up water, for the needs of the stock and the irrigation of the land, from the exhaustless supply below the ground. An esiimate has recently been made of the capacity of a windmill running ten hours a day for six months. It was found that an average wheel, twelve feet in diameter, with the wind blowing sixteen miles an hour, is capable of pumping 1,920 gallons an hour, 19,200 in a day of ten hours, 576,000 each month, and 3,456,000 gallons in six months. This is the work of only one windmill. Add to it the work of hundreds and thousands of others, and realize the vast amount of water brought into use by this means. It is difficult to appreciate the significance of this work and the value of the windmill as a factor in the development of the country. It means, in the first place, an abundance of water for stock and irrigating purposes, and water always means a great increase in the productiveness of the land. This is followed by an increase in values and the possibilities of larger population, bigger crops and better prices, and more business and increased earnings for the transportation lines. This is what the windmills are helping to do in America.

THE GREAT UTAH GREEN RIVER OIL COUNTRY.

Watch for the biggest Boom in here of any yet.

By FRANK E. PLUMMER, Banker and Broker, Minneapolis, Minn.

FRANK E. PLUMMER,
Minneapolis, Minn.

THE vast Oil fields in Utah is the marvel among oil men. The field takes in Eastern Utah, Western Colorado and South Western Wyoming, up and down the now famous Green River. The center of this lies in about where the Rio Grande Western crosses Green River in Grand County, Utah. The wide extent of the field and the exceedingly high grade of the oil characterize this new and wonderful oil field.

The oil is high grade—56 per cent. illuminating and 41 per cent. lubricating. It is the highest grade oil yet discovered. As the formation is sedimentary, largely sand and shale, the drilling is exceedingly easy. The development in the field has jumped the price of the land to many times what the property cost us, and before long these lands will command fabulous prices. A greater boom will strike these fields, it is predicted by the competent oil men, than ever was in Texas and California. This will be largely due to the high grade and high price of the oil, as it is worth about $6.00 per barrel.

Here is what some of the experts say in regard to this Oil:

SALT LAKE CITY, UTAH.

"I have made a thorough service test of your oil using it on one side of the engine, and the Gelena oil on the other side with equal results. I tested your oil on both the steam end and the air end of an air pump and found that it works first class in both, hence is a good article as cylinder or valve oil and is equal to any lubricating oil used by our Company."

(Signed) J. G. BYWATER,
R. G. W. Ry. Co., Engineer.

Mr. W. A. Twombly, a prominent oil expert of Boston says:

"I regard it as one of the biggest oil possibilities into which I have ever inquired. Certainly the lubricant is superior to any I have ever seen, the quality reaching as high as 78 degrees and defying the refinery. Without refining this oil may be applied to the most sensitive machinery without the fear of a scratch and if the railways will adopt it there will be fewer hot boxes."

Mr. Taylor, chemist of the Standard Oil Company, says:

"It is the best natural oil for cylinder stock I ever saw."

Mr. Robert Hutchinson, chemist, Glasgow, Scotland reports:

"The body is far in excess of any mineral oil I ever came in contact with. It will, I believe, be without a competitor in the market."

Mr. S. L. Boggs, 405 D. F. Walker Bldg., Salt Lake City, Utah, is a thoroughly reliable oil man; experienced in Pennsylvania oil and Pioneer in the GREEN RIVER OIL, has just sent me a few field notes showing the movements going on right around Little Grande. There are over 100 rigs going in now in various parts of the field and by summer the boom will be fully on.

Write Mr. Boggs for any detailed information that you want. He is an official of the Oil Stock Exchange and will be

glad to furnish you facts if you are interested.

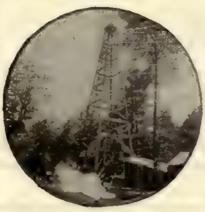
John Eaton, President of the Oil Well Supply Company, of Pittsburg, Pa., and Mr. Albert Brown, manager of the Florence, Colo. branch, looked the field over and were so favorably impressed that they will establish a branch house in Salt Lake City and a Supply Depot at Green River.

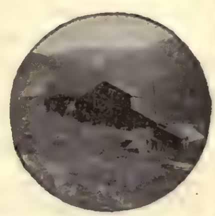
The importance of the Green River Oil basin is now recognized by the leading oil papers of the East and West. Both the National Oil Reporter of New York and the Pacific Oil Reporter of San Francisco devote considerable space in their weekly journals to our fields.

RECORD BREAKING SALE OF OIL LAND. Syndicate pays $5,875,000 for 108,000 acres in Wyoming, Utah and Colorado—New York, Chicago and California Capitalists interested.

This land, an absolute desert you may say, while with irrigation facilities it would be worth several hundred dollars per acre. It is worth that and many times that because of their wonderful oil product.

If you are thinking of an oil investment you want to look up the GREEN RIVER FIELDS for there is nowhere a better chance for speculation than there. Look into it, if you would not have a wonderful opportunity pass you by unnoticed.





Herd of Range Cattle.

Great Grazing Ground.

"Arid America," once the home of the Buffalo and Indian, has now become the pasture land of Agricultural America, whereon is raised the beef and mutton not only for American consumption, but for exportation abroad, in enormous quantities. Cattle and sheep, are born, raised, grazed and fattened upon the nutritious native grasses, and thence shipped direct to market. The profits are so great that new ranches are being started every day. Union Pacific lands are selling at the rate of 100,000 acres per month to men who are entering the business, or, who having made the start are devoting their profits to the enlargement of their operations. Write the undersigned, for an illustrated pamphlet containing a map and full information concerning

Profits in Sheep and Cattle.

B. A. McALLASTER, Land Commissioner. **Dept. B., Omaha, Nebraska.**

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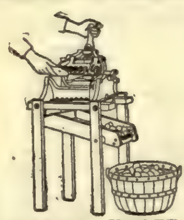

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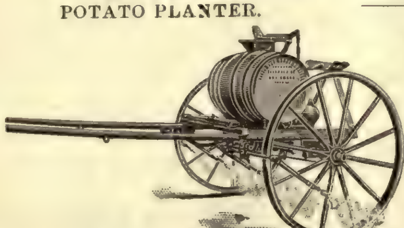

4-ROW POTATO SPRAYER.

Joel Shomaker.

THE IRRIGATION AGE.

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THE IRRIGATION AGE.

D. H. ANDERSON PUBLISHING CO.,
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A monthly illustrated magazine recognized throughout the world as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world, and has no rival in half a continent. It advocates the mineral development and the industrial growth of the West.

D. H. ANDERSON, - - Editor.

Fatally Injured. We regret to announce that Geo. P. Bemis, whose article entitled "Points on Irrigation" appeared in our last issue, was fatally injured in the heavy wind storm which visited Omaha, Neb., April 25. Mr. Bemis was twice mayor of Omaha, and has been closely identified with public affairs.

The Irrigation Bill. The passage of the irrigation bill, now before Congress, seems well assured. The bill provides for the construction of irrigation works for the reclamation of arid lands "so that they may be made homes and permanent abiding places for the settler and his family." The strongest opposition to the passage of this measure has been from the Eastern farmer, who argued that the government construction of reservoirs in the arid regions would subject him to taxation in the interest of competitors in his own line. This very human reasoning is also very narrow and selfish. Laws should be made looking to the ultimate welfare and prosperity of the whole nation, not to the aggrandizement of one section; and not alone the present welfare but toward the future prosperity as well. To use a much over-worked expression, it should provide for "the greatest good to the greatest number." The following words of Mr. Pomeroy, senator from Kansas, in speaking of the homestead law are particularly applicable: "And here let it be observed that the wealth of a nation does not consist in the money paid into its treasury, exacted, as it often is, from half-paid toiling millions, nor in an endless unoccupied public domain, running to waste with wild men and wild buffalos. * * * * The wealth, the strength, the

greatness of a nation consists in the largest number proportionate to the whole of happy, contented, virtuous, and independent families it sustains. And I care not what other means of subsistence men may devise." To furnish homes, where now is arid waste land, is the object of the bill now pending.

The opposition to the measure has not, unfortunately, been confined to the East, but, has come from certain ones of the irrigationists themselves. It is unfortunate that when competent men succeed in framing a bill which very nearly meets the requirements of the situation they cannot have the cordial support of all pretending to be interested in the cause of irrigation. It is hard to get up a bill which will meet every requirement and be just what its originators hope for, but when this is, in a great degree, accomplished, all interested in the subject should support it. Regarding this, Hon. C. D. Clark, of Wyoming, said in a recent speech before the senate:

"I believe it to be the universal experience that whenever a matter of great public interest is brought to the attention of Congress, or any other legislative body, that some person, in his own proper interest, arises to combat the conclusions of those who have arrived at a satisfactory solution of the matter presented, and will never be contented unless his individual views be embodied in the final solution.

"There is now extant a certain publication known as the 'National Homemaker,' purporting to be published at Washington, D. C., and to interpret the views of those who are the true friends of irrigation and the reclamation of the arid land. Nowhere within the covers of said publication is found the name of anyone who is responsible for the same, and from cover to cover it seems only to express the individual views of one or two persons upon this great subject of national aid. * * * * So far as I am informed, it has no subscription list, represents no organized effort in behalf of irrigation, but in its editorials, illustrations, and general trend opposes the pending bill and everything that looks toward the reclamation of the public lands except as the same shall be accomplished through absolute and unqualified appropriation of public moneys to a national project. * * * It can but appear that the effect if not object of the publication and of the editorials mentioned is to either postpone indefinitely any action of Congress upon this question or to build up a bureau in the Government service for the individual remuneration or aggrandizement of certain ones opposing the theory and form of the present bill."

Significant. Our readers may note that THE IRRIGATION AGE is now carrying more advertisements of strong manufacturing concerns than ever before in its history. During the past two years more attention has been given to developing a good strong subscription list than to the matter of securing advertising. We now feel that our paid list of subscribers is sufficiently strong to warrant exploiting it. The legitimate advertiser only is solicited, and we can honestly and heartily indorse any claims made in our columns by advertisers.

A Request. The editor would like to hear from individual irrigators giving their experiences, including failures as well as successes. Send in such matter as you may consider will be instructive and interesting to others situated like yourself. If you do not find time to prepare matter of this sort in as careful manner as you would possibly like, send in a rough draft of your experiences and we will re-write it and put it in proper shape for publication.

Indorsed by the Manufacturers. When, at the Republican convention of 1860, Abraham Lincoln—then a comparatively un-

known man—received the presidential nomination, a disappointed contingent from the rural district drawled out: "Abe Lincoln! Now who in h—l is Abe Lincoln?" He proved to be the man raised up for the occasion. So with irrigation. A few years ago, at the mention of the word, the eastern or middle state farmers said: "What is this irrigation? Oh, yes, they use that out west and in the deserts of Egypt." They had heard of it, as they had also of the pyramids; it was interesting, perhaps, in a casual way, but that the subject would ever be a vital one in this country was not thought of. Now, these same men acknowledge that irrigation is a "great thing." From the little-known art practiced in the western sections it has become a recognized factor in the economic conditions and must be reckoned with among the other great social problems confronting the nation today. One of the most striking proofs of the progress irrigation is making is the fact that at the seventh annual convention of the National Association of Manufacturers, held at Indianapolis April 17, among the resolutions passed was one asking "for the irrigation of arid lands." This proves that not only the farmers themselves, but the manufacturers, are awakening to the possibilities of the arid west and to the urgent necessity of irrigation.

Why Prices Are High. There is hardly anyone of moderate means who has not felt, in a slight degree at least, the hardship entailed by the high price of provisions. An increase in the price of any necessity works the greatest hardship on the poor, and in view of the almost prohibitive price of meat at the present time, the governmental inquiry now being made regarding the alleged beef trust will be hailed with joy by those who are not vegetarians. Ten years ago there was an investigation to discover why the price of cattle was so low. Now, it is claimed, live stock received at the six principal markets during tho last six months has netted the farmer from forty to fifty million dollars more in money than last year during the same period. The packers claim that the price of cattle on hoof is higher than it has been for twenty years, the greatest advance having taken place in the past few weeks. They further claim that the supply has diminished 1½ per cent. in number and 5 per cent. in weight, while the consumptive demand is greater than ever before. "The people of the South," says the *Chicago Tribune*, relative to this subject, "have been educated in the use of fresh meat, and whereas formerly they lived mainly upon 'hog and hominy,' they now have beef. The big packing-houses in Chicago have established branches all over the South where formerly they had none. The export trade, until quite lately, has been larger than ever before. The failure of the corn crop put a good many farmers out of business as far as cattle raising is concerned. There are as many cattle in the country, but not so many in marketable condition."

Secretary of Agriculture Wilson, in a recent interview on this subject, said:

"I am not an expert on the trust question, but I do claim to know something about the raising and selling of beef. Others may talk about the 'beef combine, as much as they like, but to me the raise in the price of beef is very easily explained. It is due almost wholly to a short corn crop last year, and a great demand for beef caused by the prosperity of the people of the United States. The high price of corn has made it necessary for Western cattle feeders to send to the South for cottonseed meal to feed their stock. * * * There is a great demand for cattle, and that means a great demand for beef. The people of the United States are eating more beef now than they ever did before in their history. This is because they are making money and spending it. * * * Under such circumstances it is only natural that the price of beef should advance. Cattle and meat, like all other commodities, have to follow the laws of supply and demand."

A Blow at the Trusts. The Cuban reciprocity bill was passed by the House, April 18, after an amendment had been added reducing the tariff on refined sugar to that for the raw material. As it goes to the Senate the measure authorizes the President to negotiate a treaty with the Cuban government, admitting Cuban imports to this country at a 20 per cent. reduction from existing tariff rates. This is regarded as a censure on the sugar trust and is received with pleasure by Westerners.

To Irrigate By Wells. Arizona and Texas capitalists have organized a company at El Paso for the purpose of irrigating 40,000 acres of desert land in the Rio Grande valley for farming purposes. It is said that at a reasonable depth a continuous flow of water may be secured, and it is therefore proposed to divide this land into small tracts and irrigate it by means of wells. The land can be purchased so cheaply that the only expense to amount to anything will be the cost of sinking the wells. Should this method prove as successful as its projectors hope, it will doubtless be used in reclaiming arid lands in other regions. The claim is made that if the desert land in Utah, California, Wyoming, Arizona and Texas were combined it would make one of the largest deserts in the world with the exception of the Sahara. The southern portion of Texas is certainly in a bad way at present. A traveler who recently returned from there said that there were sections where no rain had fallen for two years and where the wild animals, in large numbers, had died from the effects of the drouth. The northern section of the state has been helped by some rain.

A New Departure. We present in this issue, under the heading of "Legal Notes on Irrigation," information regarding subjects of such general interest to irrigators as "riparian rights," "prior rights appurtenant to land—deeds," "what may not be appropriated," etc. This is a feature which we trust may be well received by our readers. Law is a very handy subject to have some knowledge of, in irrigation as well as in other pursuits.

A Word to Our Advertisers. Advertising pays. Not the spasmodic kind, perhaps, for people are forgetful; but the constant keeping of your name before the public cannot fail to make your name known and to sell your product, whatever it may be if it is a worthy one, and if the medium in which you advertise is a reliable one. By a reliable advertising medium is not necessarily meant one with the largest circulation, but one which reaches the largest number of people you desire to interest. Thus an agricultural paper, with a circulation of only 1,000 farmers, would be a better medium through which to tell the country dwellers the merits of a fertilizer than a paper of, say, five times its circulation going to the city dweller. Therefore, select the publication best calculated to your needs and then advertise—not once-in-awhile, but regularly, persistently, and with not too great impatience for results.

MODERN IRRIGATION IN ARIZONA.

BY B. A. HADSELL, Maricopa Co., Arizona.

In the February number of the IRRIGATION AGE Judge Cleeson S. Kinney gives us a very interesting and profitable account of ancient

Divertion Dam of the Arizona Canal on Salt River, 28 miles east of Phœnix, Arizona.

irrigation. As I am a resident of the Gila valley, which he refers to as being the most extensively irrigated of any portion of North

America, judging by the relics, I desire to call attention to the difficulties we have to contend against which may or may not exist in other places.

One of our greatest is the small amount of fall in the Salt and Gila rivers after they leave the mountains, probably ranging from three to seven feet per mile. As the valleys lay twelve or fifteen feet above the river the canal must be started up stream from five to fifteen miles, with a fall of from 18 inches to two feet per mile, to get it on the land. The bed of the river is sediment, sand and gravel for an unknown depth, and a mason dam is, therefore, out of the question, while brush and rock or lumber dams can only be used to raise the water a few feet.

The Arizona timber dam, shown in this number of the AGE, is the highest dam in use on the Salt or Gila rivers, on a sandy foundation. It had a section taken out during the flood of 1891, but it has held all right since that. The Woolfy dam, on the Gila river, which was built of lumber similar to the Arizona and with a sandy foundation, attempted to raise the water 18 feet, but the height was too great and the apron on the lower side was not long enough to carry the overflow a sufficient distance from the dam and it soon settled, a portion of it being carried away, leaving a canal, probably fifty miles long, large enough to canal boats, but without any water, and it is still unused. This canal covers one of the finest valleys in the world; the depth of the soil has never been found. It is traversed by railroad, with a number of towns and shipping stations. Without water this land is a desert; with water it would furnish six mowings of alfalfa, or keep two to three head of cattle per acre on pasture the year round. Had this dam held it would have supported a hundred thousand head of cattle and a large population.

With a little government aid, or even by the combining of private capital, it can be made a success yet. The present dam is located at a bend of the river where it narrows down to less than half its usual width, as it passes between two mountains of solid rock and, had there been a rock bottom, a better location could not have been asked for. A low dam would probably have held. By running the canal up stream several miles the bed of the river can be tapped, securing a large portion of the invisible underflow, which would probably more than double the amount of water in the summer where a dam is used to raise it.

Up to the present time all of the ancient and modern canals depended on diverting the surface water from the stream by a dam; the lower a dam the less it took to keep it in repair, no attempt being made to secure the underflow, which is very strong and will probably average two miles wide. A well ten feet,—eight feet square, sunk

into the underflow, will stand a continual pumping of 120 miner's inches of water by actual test. Another party secured 400 inches by making the well larger and deeper. I therefore prophecy that the day is coming when we will change our system of irrigation by running up stream until we get into the underflow, and do away with the dams. Some will probably have their headgates at the mouth of tunnels, where the mountains come to the river, in order to secure solid masonry, keeping the canal back from the overflow. Others will doubtless start from large wells, or crosscuts, back from the river, doing away with dams and head-gates.

The man who can invent a cheaper power, with a large pump for raising large bodies of water, would probably give the greatest blessing that an inventor could bestow upon the arid west, as it will do away with many miles of canals, dams, head-gates, and damages by flood water. While we would desire more fall, we are encouraged to hear Judge Kinney say the Nile, of Egypt, has only eight inches fall per mile, and that in ancient times they made a grand success irrigating that valley for 720 miles, including the desert on both sides.

The second problem we have to contend with is a large amount of sediment carried by the streams after they leave the mountains, as the banks melt almost like sugar during a flood, filling up dams, reservoirs and canals. However, it is as good as a coat of manure when spread over the land, and the longer it is in cultivation the richer it becomes, and needs no other fertilizing. At present the canals have head-gates through which they allow flood-water to pass so as to keep a channel open from the river, having a sluice-gate where they let off the bottom, which is the heaviest of the flood-water, in order to save filling up the canal. These floods only occur a few days during the year.

The people of Salt river valley have formed a district and are trying to arrange to put in a mason dam on Salt river in a box canyon, 200 feet high, as a reservoir to store the flood-water and to catch the underflow before it reaches the sandy valley. Owing to the high freights we have not resorted to piping the water, but the time will probably come when pipes will be largely used, possibly to syphon water from the streams or underflow over the mountains, irrigating lower valleys on the opposite side wherever there is sufficient fall.

SHALL THE UNITED STATES LEASE ITS GRAZING LANDS?

By John P. Irish.

When adventure, going Westward, Ho! had passed the 100th meridian west of Greenwich, it had left behind the humid influence of the Great Lakes, and entered a region that has its water supply a great many miles away. Of the vast arid and semi-arid area, the United States owns about six hundred millions of acres. Of that total it is estimated that one hundred millions may be irrigated by supplementing the natural reservoirs and storing the storm waters for gravity distribution. Another hundred millions may include the forested and semi-forested land, which should all be reserved and cherished as jealously as Naboth guarded his vineyard.

The remaining four hundred millions of acres are grazing lands. In their virgin state these were covered by a vast variety of forage plants, each affording pasture in its turn and season. They supplied a succession of feed for live stock on the most valuable and extensive grazing area in the world, not excepting the pampas of the Argentines. But they were on the public domain, free to everybody, where all live stock was a free commoner. The Government had dealt so with the public lands west and north of the Ohio River to the Loup fork of the Platte, where no dry season interrupted the growth and renewal of the natural forage. Everybody had ranged his stock on those moist prairies until they were conquered by the plough. Why, then, should not everybody have the same privilege wherever the public domain lay? Everybody enjoyed that privilege. But instead of grazing only domestic stock, the great beef herds were created. It was the most economical production of beef. Chicago built stock-yards and slaughter-houses to receive it; Omaha and Kansas City followed; and for years the ranges poured out a stream of cattle to meet the pole-axe, supply the domestic market, and furnish a profitable export trade.

Then the supply slackened. The census of 1880 showed a decrease in the number of cattle per capita of our population. That of 1900 exhibited an accelerated decline. The delivery of range cattle to the slaughtering centres fell off sixty per cent. in six years, and the price of beef on the butcher's block rose more than forty per cent. Then men said that there must be something the matter; and the United States hydrographers went out into the arid region where they found that, although the Japan current was still supplying moisture,

the crust of the earth was dry. The watercourses had been cut into deep channels, were torrents when rain fell, and then ran immediately dry. Springs had lost their affluence. The blear desert had overspread the meadow.

The hydrographers were followed by the agrostologists of the Agricultural Department. They found that the grasses, forage plants, and browse shrubs were gone. All nature's nice adjustment to prevent evaporation from the soil and to open it for absorption by the plant roots had disappeared. Her equilibrium had been destroyed. The water no longer went steadily and slowly through the soil to feed springs and maintain the even flow of streams without deepening their channels; but it rushed over the denuded surface, eroded it, and appeared at once in the drainage channels as a mad torrent. The flocks and herds, grazing as free commoners, had eaten the forage, destroyed the stable moisture, and left desert and desolation behind.

The pioneers of all that widespread region could be called as witnesses regarding the former and present physical conditions, and the destruction of its sole potentiality of wealth. Let one witness utter the testimony of all, whether they come from New Mexico, Arizona, Wyoming, Nevada, or any other state or territory in that domain.

Mr. Bayless, of Oracle, Arizona, in a letter to the Government agrostologists, says that the rich grasses of San Pedro valley are gone, and that the river channel is cut down from three to twenty feet. The valley is a sandy waste from bluff to bluff. Cutting down the river channel impairs or prevents its use for irrigation. These results are due to the use, free and in common, of the land for grazing. The average rainfall still comes, but nature's mode of conservation has been destroyed; and where, twelve years before, 40,000 cattle fed and fattened, 3,000 famine smitten creatures now eke out an existence. Mr. Bayless adds that very few of these cattle were sold or removed from the range, most of them having been left until the pasture was destroyed, when they perished by starvation. The same story can be told of a vast majority of the four hundred million acres of grazing lands in the West, which belong to the Federal Government. Cattle have grazed below the point of sustenance for them, and sheep have followed to eat what remained to the roots and tramp the surface into dust. The agricultural settlers have their freeholds invaded by nomadic flocks and herds. Rival stockmen hold a portion of the range with winchesters. Homicides redden the struggle for survival, and a great industry is dying of starvation. The whole region has less water for irrigation; and yearly grows less inviting to the settler who seeks a home supported by that means. Is it not possible to end the struggle, to call back the forage, to stop the march of the desert, to restore the equilibrium of nature?

The Secretary of Agriculture, the hydrographers and agrostologists, and every thoughtful observer who lives in contact with these distressing conditions are agreed in their suggestion of the means of restoration. They are not without a precedent to support their advice. The stock ranges of Australia, under the same physical conditions, had the same history. Nearly twenty years ago the Colonial Governments called the stockmen into council, and there was devised a leasing system protecting the rights of agricultural and pastoral freeholders and of large and small stockgrowers. Each one got a leasehold. He confined his stock to it, changed its grazing ground, and carefully nurtured the re-seeding of the forage, with the result that the carrying capacity of the Australian range is now restored to its virgin state.

Texas owns her own domain. A vast area of it is pastoral and arid. When used free and in common the land became bleak and repellant, its forage being destroyed. A steer could barely live on a hundred acres. Less than a decade ago, against the opposition of the stockmen, Texas made a leasing law. Now an area of seventeen acres supports a steer. The range is restored, and a proposition to repeal the lease statute would convulse the state. The United States found the range on the Indian reservations destroyed. It leases them; the leaseholders protect a restoration of the forage, and the desert has retreated before the meadow. Colorado, Idaho, Montana, Nebraska, Utah and Wyoming lease their state lands, the school sections, lien lands, etc., for grazing, at an average of one cent and eighty one hundredths per acre, and derive from that source an aggregate income of $1,108,754 per annum. The forage on these state leaseholds has been protected to the point of restoration.

Moved by these examples, and stimulated by the decadence and drouth that follow the extirpation of the forage, the National Live Stock Association, in session at Fort Worth, Texas, two years ago, resolved in favor of a Federal grazing lease. Similar resolutions were passed by the American Cattle Growers' Association, in annual convention at Denver, March, 1901, with only four dissenting votes, and by the Paciffc Stockmen's Association, in annual convention at San Francisco, January 14, 1902. The Secretary of Agriculture ably supports this proposal in his last report. The President of the United States, in his message of last December, draws a graphic picture of the destruction wrought by the free use in common of the grazing domain. The legislation committee of the American Cattle Growers' Association has drawn a bill for a Federal leasing act, which, after having been introduced into the House by Mr. Bowerock, of Kansas, appears in Senate Bill 3311, introduced by Mr. Millard, of Nebraska. It leaves every leasehold open to the homestead entryman under ex-

isting and future laws, and also to the mineral entryman, thus offering no obstruction to the actual settler. In allotting the leases it provides:

Preference for leases shall be given to owners of cultivated agricultural land for leasable lands abutting upon their freeholds, in proportion of ten acres of leasehold to one of freehold. A preference of ten acres of leasehold to one acre of freehold shall also be given to stockgrowers who are also freeholders. This preference shall apply only to lands within counties upon which their stock habitually ranges. If, in case of either of the preferences above provided, there shall not be sufficient leasable lands in the county to give each person entitled to the preference the maximum proportion of ten acres to one, then said lands shall be prorated between the persons entitled to such preference. The further preference to lands not leased under the foregoing provisions of this section shall be given to stockgrowers who were in actual use and occupancy of said lands during the year ending January 1, 1901, to be leased to them in proportion to their respective interests in and use thereof. Where the States lease State lands, the bona-fide holders of such State leaseholds shall be beneficiaries of the preference given to stockgrowers who are also freeholders: provided, That such State leaseholds are not held by any one person in tracts exceeding six hundred and forty acres in one body.

At the price fixed, the leasable area will produce a revenue of $8,000,000 annually. It is provided that this shall go into the Federal treasury, as a fund for irrigating all irrigable lands in the region where it is earned. Whenever the Federal Government, a State, or private enterprise provides water storage and distribution for irrigation, all lands subject thereto are cancelled out of the lease without compensation to the leaseholder. The fund will be large, and will protect the Treasury against any call for tax-derived revenue for irrigation.

Why should the East oppose such a measure? It protects equally freehold rights and those of small and large stockgrowers. None can be excluded. The lands which the revenue irrigates will not compete with Eastern farm lands. They cannot produce grain for export, as it will not bear transportation. With inappreciable exceptions, the most profitable use of this land will be in the production of hay as winter feed for stock. But unless the dry summer range is leased and protected, and its forage restored, there will be no stock to eat the winter feed. The symmetrical, economic development of the arid region and its profitable use depend upon the restoration of the summer range. The proposed law is good business. It derives an irrigation fund from an existing public asset—an asset that has enriched the user who has enjoyed it free of cost until a large part of it has been destroyed, while the rest is following in the same direction at a rapid pace.

If free use in common of the public domain east of the Missouri River had destroyed its potential wealth, dried up the springs and streams, poisoned it with desert conditions and made it unfit for settlement, does any one imagine that such use would have been permitted and its effects borne without any effort being made for a remedy?
—*The April Forum.*

IRRIGATION IN FIELD AND GARDEN.

BY PROFESSOR E. J. WICKSON.

(Reprinted from Farmers' Bulletin No. 138, issued by U. S. Dept. of Agriculture.

DISTRIBUTION OF IRRIGATION WATER.

For the conveyance of water from the source of supply to the ground to be irrigated, as well as its distribution thereon, the ditch is the prevailing agency. The laying out and constrction ot ditches has been already discussed.[1]

Their obvious advantages are cheapness and durability. The chief disadvantage lies in the loss of water by evaporation and seepage. Where the water supply is scant and where the soil is so open that the loss of water by seepage is likely to cause injury to good land or lower levels, the savings of these losses may justify the expenditure necessary to prevent seepage by paving or cementing the ditch, or to insure delivery of water without loss from any cause by the use of a pipe line. These are usually questions connected with large irrigation enterprises rather than with the use of a farm supply, and yet they sometimes arise in connection with the latter. In regions where the ground does not freeze a thin coating of cement or asphaltum on well-made ditch banks and bottoms will prevent all losses from seepage. Where flat stones are plentiful, they are readily made into a stone ditch with cement mortar. Such ditch linings are, however, liable to be upheaved by freezing and are safe only in moderate winter climates.

The board flume is upon the whole the most available recourse when the simple open ditch will not answer, and the cheapest flume for carrying a small stream of water is the V-shaped trough of two wide boards nailed together along two edges and bedded in the soil with shoot cross-pieces under the end joints This prevents loss of water by seepage, reduces friction, and delivers the water rapidly with a very slight fall and escapes the erosion of a dirt ditch if the slope is sharp. Even where the water must be carried over an uneven surface in a flume supported by stakes and cross-pieces, the bedded V-flume is still desirable for the parts where a good grade in the earth can be found.

The various ways in which water is distributed for the growth of fruits, according to the slope of the ground and character of the soil, have been discussed in such detail in Farmers' Bulletin No. 116, that

1 See also Yearbook U. S. Department of Agriculture, 1900, p. 492.

the reader is again referred to that publication. The principles and practices there presented are also of wide applicability to the use of water for field and garden crops, and should be considered therewith.

Distribution by a system of underground pipes with standpipes, hose, and sprinkling devices is not widely practicable, because of the cost of the outfit. It is true that in intensive horticulture the return may be so great from a small area that the investment may be found profitable, but such investment is out of the question for common crops, and the cheaper way secures a welcome saving in the cost of production of even the highest-priced commodities. One must be quite sure of his market when he makes large investment in facilities for production, and the fact that market gardeners and small fruit growers in irrigated regions never resort to the showering method is a demonstration that the risk involved in such large investment is unnecessary. For the growing of home supplies or commodities for sale in low markets the investment required for showering would practically prohibit resort to irrigation.

LOCATING THE FARM DITCH.

Contour lines are prime factors in all systems of distribution of water by natural flow, or, as they are commonly called, gravity systems. For this reason pains should be taken even in small undertakings to mark out these lines with approximate accuracy. The use of the triangle for work of this kind has already been suggested. From the highest point on the land to which the water can be brought the main supply ditch should be laid out as nearly along a contour line as will give sufficient fall for the water to flow. If this main ditch be carefully laid out and well made the water can be taken out and carried by lateral ditches or flumes along lines of nearly equal elevation in any direction in which there is a slope away from the main ditch, or it may be dropped from the main ditch through pipes or wooden flumes to lower lines or ridges from which distribution can be made.

By studying the relations of the different surfaces, or irrigation faces, to each other and correcting visual impressions with the use of the triangle, the farmer can carry the water to every point of a very uneven piece of land and successfully avoid both cutting and overflow throughout his whole system of ditches and flumes. This is done by getting even grades and the least fall that will move the water. The general tendency is to give ditches too great a fall.

DEVICES FOR TURNING WATER FROM DITCHES.

The crudest way to turn water from a ditch is to make a cut in the side with a spade and throw the dirt into the ditch to make a dam. Some simple home-made devices will obviate the manifest disadvantages of this method. Three will be described, and others will suggest themselves to the ingenious irrigator.

The cloth dam (Fig. 9) is very widely used. It consists of a rectangular piece of stout, closely-woven cloth or canvas, one side of which is rolled around and nailed to a crosspiece of wood of length and strength according to the size of the ditch and the amount of water to be dammed. Sometimes it is made with a hem across one side deep enough to allow the crosspiece to be thrust through the hem, In using the dam, place the stick across the top of the dry ditch where it is desired to throw the water out; draw the lower edge of the cloth up the bottom of the ditch and place a little dirt on the corners. (See Fig. 12) The canvas must always be large enough to have several inches lap against the sides of the ditch; otherwise it will not retain all the water. Should the ditch have a steep grade it will be necessary to let the canvas fill up gradually, as a sudden rush of water would force the cloth from its position. When the dam is in position it will be necessary to cut the bank of the ditch at the places where the water is wanted. Two cloth dams will be needed in order to place one in position while the other throws the water out above, it being difficult to lay the canvas under a full head of water. The water will press the canvas against the sides and bottom of the ditch, so that none can escape. To remove the cloth, take hold of one end of the scantling and pull slowly up stream.

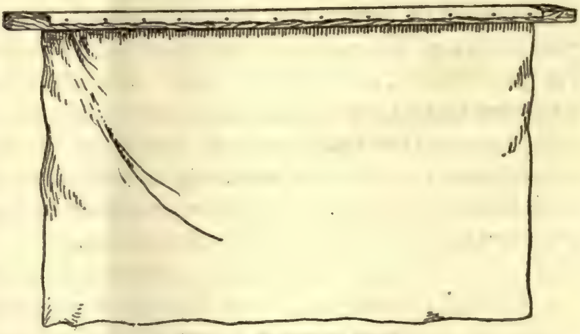


Fig. 9. The Cloth Dam.

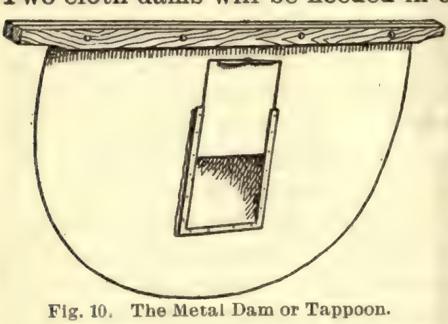


Fig. 10. The Metal Dam or Tappoon.

A metal dam or "tappoon" is on some accounts preferable to the cloth, and it, too, is readily made. Heavy sheet iron is cut into semicircular shape and the straight edge is securely fastened between two narrow strips of wood by carriage bolts which pass through the strips and through holes punched in the iron sheet (Fig. 10), or it may be more cheaply made by securely nailing the iron to one side of a single thicker strip of wood, like a piece of scantling. These metal dams are made of different sizes according to the ditch in which they are to be used, their diameter being a little more than the width of the ditch, as the edges must be pushed down a little way into the earth of

the ditch bank and bottom. They are placed in the ditch at or near the point where it is desired to turn out the water. These metal dams are also used in the openings in the banks of ditches either to close them when checks are full, or to partly close them and still permit part of the stream to enter the check to balance the soaking away. They are made with sliding gates, as shown in Fig. 10, to be used when part of the stream is to be allowed to pass through for any purpose.

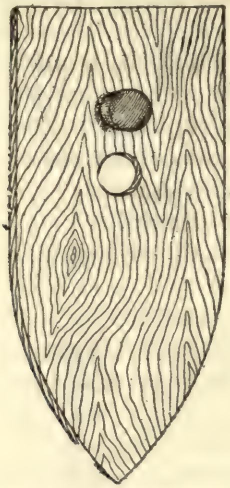


Fig. 11. Small board dam or gate.

Portable wooden dams are also used and are of similar form to the metal dams. They serve a good purpose, but are more cumbersome, more likely to give out, and more difficult to make water-tight except with some shoveling. Wooden dams are, however, of much use in quite small ditches and as gates for small outflows into checks, etc. Figure 11 shows a simple wooden contrivance which is widely used. It is made of an inch board 6 or more inches wide and 14 inches long. The lower end is pointed so as to be readily driven into soft ground. Above are two holes about an inch in diameter, one or both to be used according to the flow of water desired. The cut is made in the ditch and the board driven well toward the inside of the ditch to avoid a niche to catch sediment. If a large flow is desired the board is pulled out and afterwards replaced when it is desired to stop or reduce the flow. This device works very well in small ditches.

METHODS OF APPLYING WATER.

When the distributing system has been secured methods of application to the land must be determined upon in accordance with the slope of the various irrigation faces and the crops to be grown upon them.

The methods in which application is made in field and garden practice include the following:

(1) Free flooding, or running water without restraint except that afforded by the banks of the laterals conveying it.

(2) Flooding in contour checks, or irregular-shaped inclosures which are determined in size and shape by the inequalities of the surface.

(3) Flooding in rectangular checks, or inclosures which are approximately of equal size and with level bottoms.

(4) Depressed beds, with raised ditches on the levees which hold

the water until it soaks away among the inclosed plants—a garden modification of the rectangular check system.

(5) Ridge irrigation, in which plants are grown on the sides or at the bases of raised ditches—a simple form of depressed-bed irrigation.

(6) Furrow flowing, or running water in one or more furrows between the rows of crops grown in that way.

(7) Raised-bed irrigation, in which the water is taken by seepage and capillary action from a small ditch on each side—a modification of the furrow system.

(8) Subirrigation; or distribution by means of pipes with suitable outlets, or from blind ditches filled with material permitting circulation of water which will reach the plant roots by capillary action.

(9 Underflow irrigation, by which the ground water is raised by percolation from ditches at intervals of considerable distance—the plant roots being reached directly or by capillary movement.

(10) Distribution under pressure in underground pipes, with stand-pipes and connections for sprinkling.

FREE FLOODING.

Free flooding is the oldest and simplest form of field irrigation and consists in turning water out upon the land with only the inci-

Fig. 12. Irrigation of a grain field by free flooding, showing cloth dam in position.

dental restraint of the banks of the ditches, from which it is released usually by spade cuts at intervals, or by overflowing the banks them-

selves. On slopes the water may be carried in temporary laterals plowed out approximately on the level, or such laterals may be permanently made and retained, as their low sloping banks need not interfere with the crossing of field machinery. The water has free flow down the slope until the overflow is caught by the next ditch below and flows from it to the lower slopes.

The evenness of the distribution depends in part upon the uniform grade of the land and its freedom from knolls or hummocks and in part upon the ditches being level; for then as they fill there is an overflow all along the lower banks and all points are reached in the downward movement of the water. On nearly level lands the temporary ditches are made by plowing two furrows thrown away from each other, or by making a furrow with a double moldboard plow. A ditch thus roughed out may need but little cleaning, as very free flow of water is not generally desired.

The water is made to rise in the ditch by damming with earth, a cloth dam, or a metal tappoon, as already described, and is released by cuts in the bank as shown in Fig. 12. The irrigator aids the water to reach slighted parts by a little work with a spade here and there. When one section of the field is thoroughly wet the dam is moved to a lower point, and so on. This method of irrigation is best suited for small grain and forage plants, but the difficulty of securing an even spread of water and the amount of work required in handling the water have caused its abandonment in many places for one of the check systems, which require some outlay in first cost, but enable the irrigator to do better work afterwards with a minimum of labor. Where irrigation is not regularly needed a recourse to free flooding may save a crop when threatened by temporary drought. It is also used to some extent in the drier parts of California for winter irrigation of land to be plowed and sown to grain as soon as the soil dries sufficiently for it. Land deeply soaked in winter will mature a grain crop without subsequent irrigation. In this case it is merely a substitute for winter rainfall.

(TO BE CONTINUED.)

WIND AND WATER

TAKE GOOD CARE OF YOUR IRRIGATION PLANT.

By John M. Irwin, Freeport, Ill.

The best and strongest machinery may be quickly and permanently injured if carelessly allowed to run without oil, or with nuts working loose and bolts falling out of place. Be careful to oil the mill as often as necessary, with the best lubricating oil to be had. There is no economy in using cheap, low grade oil. Every time the mill is oiled examine nuts and bolts, and keep the nuts tight on all bolts. Should a nut be lost off or a bolt be lost, stop the mill until it is again put back in proper position. If any bearings are found to have run dry from want of sufficient oiling, and show much wear, the sooner new ones are obtained and the old ones replaced the better it will be for the life of the mill.

The tower also should receive proper care and attention. Wind mills for irrigation work are usually held into very strong winds, which put a heavy strain on the tower and will soon rack an ordinary wood tower, and has a tendency to loosen bolts in steel towers.

The pump will demand its full share of attention. The valves in the cylinder will require repairing and sometimes renewing. Should the lower valve leak, the pump will lose its priming when the mill stops; and if the upper valves leak, the quantity of water that should be delivered at each stroke will not be obtained. These repairs can be easily made by almost any one who uses a good irrigation cylinder. The owner should himself make these repairs as soon as needed.

What then? It will often happen that a cylinder of larger capac-

ity than the water supply will be put in to work on a drive well point, with the result that an unusually heavy load will be put on the mill, especially when the mill is working in high winds. As soon as it has become apparent that the cylinder is too large for the water supply, stop the mill and change the stroke from a longer to a shorter one. Should this not be enough to bring the demand of the cylinder to an amount as small as the supply of water, then regulate the mill to run at a slower speed, and thus avoid injury to the pump and wind mill.

RESERVOIRS—SLOPE OF EMBANKMENTS AND PUDDLING IN SANDY SOIL.

Reservoirs should have embankments 8 feet high, measuring from the outside, and be of such measurements in length and width as will give capacity enough for 24 hours' pumping, when the mill is working at its maximum.

Mistakes are often made by trying to use a reservoir spread over too much ground, and having the embankment too low. Smaller reservoirs with higher embankments are the best. The inner walls should have a slope of 30 degrees, or about 3 foot raise in 5, and the outer walls a slope of 60 degrees, or about 4 foot raise in 3.

When the material used for making reservoirs contains a large proportion of sand, it is necessary to obtain good black soil or the deposit from ditches to use for surfacing the bottom and inside slope of embankments, so that when puddled the reservoir will not leak. There should in all such cases be enough good black soil or deposit from ditches to cover the surface 6 inches in depth.

To puddle reservoirs where there is a large proportion of sand in the material used, the best way is to follow instructions given in our January issue, but instead of using teams with drags or barrows after water has been turned into reservoir and the surface thoroughly wet down, then turn water off and allow the surface to dry to that degree that a horse when led into it will sink to the top of the hoofs in the mud. Then employ as many horses or other animals as convenient to tramp the mud into a solid floor, which will cause the reservoir to hold water very well.

COAL TAR AND PITCH.

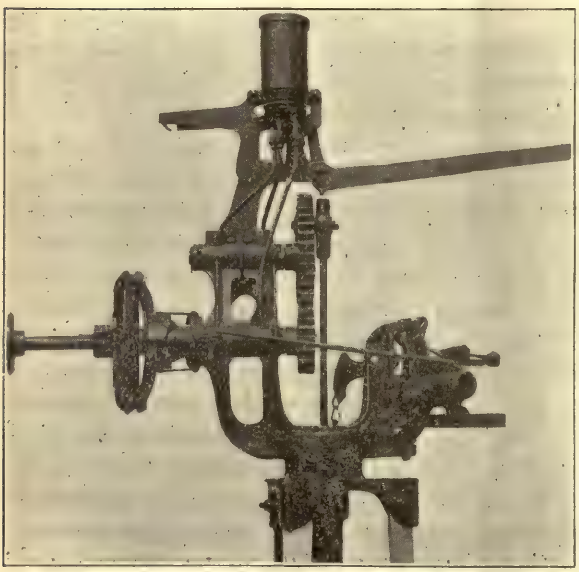
A correspondent of the *Country Gentleman* gives the followiug method for cementing reservoirs with coal tar and pitch:

After the embankment is made, it and the bottom of the tank should be tramped down hard and allowed to settle some days. Then the surface should be smoothed off with hoes and brushed out with brooms until it is as smooth and clean as possible. The inside surface is now to be covered with common coal tar and pitch—one barrel of tar and fifty pounds of pitch will be needed for every 300 square feet, or nine barrels of tar and 450 pounds of pitch for a 40 foot tank, four-

teen barrels of tar and 700 pounds of pitch for a 57-foot tank, and thirty barrels of tar and 1,500 pounds of pitch for a 95-foot tank.

Boil down the tar and pitch together until they will harden when cold; use a sprinkling pot with the nozzle flattened for pouring the pitch and tar, and distribute it evenly over the surface of the ground with a mop made of a bag tied on an old broom handle. Sprinkle sand on the tar while hot. When the inside of the embankment as well as the bottom of the tank has been covered, allow it all to dry thoroughly. Then sweep off the sand and give another coating of the tar and pitch, sprinkle with sand as before and allow to dry; then give a third coating and the job is done.

A NEW IDEA.



TAYLOR WIND MILL OILER.

Since windmills are so frequently used in connection with irrigation plants, any improvement that would be of benefit to the user of the mill is of interest to irrigators.

This cut shows an invention by Mr. M. W. Taylor for oiling wind mills by means of a small storage tank and pipes from same to bearings or wearing points of mill. It is an entirely new idea as applied to wind power and will no doubt be in good demand as soon as its merits become better known among wind mill users. A complete description with cost may be had by writing the inventor, Mr. M. W. Taylor, Waterloo, Iowa.

LEGAL NOTES ON IRRIGATION.

ORDINARY RIPARIAN RIGHTS INADEQUATE.

The doctrines relating to riparian rights in a non-arid country are of necessity greatly modified in their application to the state of things in an arid portion of the United States. At common law all riparian proprietors have the right to a reasonable use of the waters of a stream, running through their respective lands, for the purpose of irrigation; what is a reasonable use must be determined, in each case, with reference to the size of the stream, the velocity of the water, the character of the soil, the number of proprietors, the amount of water needed to irrigate, and a variety of other circumstances and conditions surrounding each particular case, the true test in all cases being whether the use is of such a character. as to materially affect the equally beneficial use of the waters of the stream by the other proprietors. (Jones v. Adams, 19 Nev., 73.)

To concentrate and regulate the general principles of riparian rights in the arid regions, irrigation districts are formed in California with extensive powers; and individual rights are merged therein to a large degree. The constitutionality of this has been disputed in California partly on the ground of inequality of benefits to individuals; but the matter has been conclusively settled in favor of the organizing legislation and the doctrine is established that "whenever it appears, from the scope of an act, that its object is for the benefit of the public and that the means by which the benefit is to be attained are of a public character, the act will be upheld notwithstanding incidental advantages may accrue to individuals beyond those enjoyed by the general public." (Matter of Bonds of Madera Irrigation District, 92 Cal., 296.)

NATURE OF CORPORATION.

In California an irrigation district is regarded as a public corporation, so that its officers are officers of the state. Ibid.

And in Colorado it is the same, so far that a company may condemn property by the right of eminent domain. (Gibson v. Cann, Colo. Supp., 879.)

PRIOR RIGHTS APPURTENANT TO LANDS—DEEDS.

Where defendant's deed to plaintiff's predecessor in title in Colorado, creating water rights for irrigation appurtenant to plaintiff's lands, gave to the plaintiff a priority of right to the water, and the former retained the right of a junior appropriator, defendant's acts showing a purpose of using the water was held not to constitute a

notice to the plaintiff of a secret agreement between the predecessor in title and the defendant modifying the rights as created by the deed, because the plaintiff had properly regarded such acts as indicative merely of an intention to use the water as junior appropriator, and held that a water right used in irrigating lands passes by a conveyance of the lands under the term "appurtenances" if the grantor so intends; and where such is the intention the grantee may maintain an action to quiet title to such right.

Also defendant's deed to plaintiff's predecessor in title creating water rights for irrigation purposes gave to the plaintiff a priority of right and the grantor retained the rights of a junior appropriator, it was held that the plaintiff had the right to change the place of using the water, and even to give it to third persons in exchange of water at another point, so long as defendant's rights as junior appropriator are not affected. (King v. Ackroyd (Colo.), 66 Pac. Rep., 906.)

A water right, though appurtenant to land, may be conveyed with or without the land. (Crippen v. Comstock (Cal.), 66 Pac. Rep., 1,074.)

WHAT MAY NOT BE APPROPRIATED.

The Supreme Court of Nevada has decided that where all the waters flowing through a tunnel are derived from drainage of a mine and of the country between the mine and the mouth of the tunnel, and from pumpings into the tunnel from lower levels and the water which has been used in the mine for electrical purposes, such waters are not subject to appropriation because they are not a natural stream passing through the tunnel. (Dec. 17. Cardelli v. Comstock Tunnel Co., 66 Pac. Rep., 950.)

And in Arizona it is held that a corporation not the owner or possessor of arable or irrigable land does not become the appropriator or owner of water diverted from a stream by a dam, canal or other conduit. (Slosser v. Salt Riv. Val. Canal Co., 65 Pac. Rep., 332.)

PRIOR APPROPRIATION.

The right to the water of a non-navigable stream for irrigation purposes may be obtained by prior appropriation, though the stream is not tapped on any portion of the public domain but on the land of the person making the appropriation. But the right of prior appropriation is limited. The following case was recently decided in Oregon: Plaintiff sued to enjoin defendant from diverting the waters of a stream which plaintiff claimed, by reason of prior appropriation, for irrigation. It appeared that subsequent to plaintiff's appropriation he had enlarged the area of the land irrigated, and had irrigated the additional land by water from other streams. It was held that plaintiff was entitled to the use of water from the stream in controversy to irrigate the amount of land he had under cultivation at the

time the appropriation was made, but not for the purpose of irrigating land subsequently cultivated. (Brown v. Baker, 65 Pac. Rep., 799.)

The rule herein stated, on which the decision rests, is this: "The first settler upon public land, through which a stream of water flows, may either divert the water and use it for a beneficial purpose or exercise the common law right prevailing in the Pacific coast states, where the modified rule of riparian ownership is still in force, and insist that the stream shall flow in its natural channel undiminished in quantity, except when applied to the natural use of the upper riparian proprietors and for irrigation, if the stream affords a sufficient quantity of water for this purpose. The right of appropriation is incompatible with the doctrine of riparian proprietorship."

STATE CONTROL.

The state may maintain mandamus to compel an irrigation company to construct bridges over highways obstructed by its ditches. (State v. Irrigation Co. (Kan.), 65 Pac. Rep., 681.)

THE CALIFORNIA RULE—STATUTES OF PACIFIC STATES.

The system of irrigation in California is, in some respects, peculiar; but the fundamental principles of the common law are preserved in a modified form, and it is still held that the right of a riparian proprietor to the flow of a stream of water over his land is an incident of his property in the land, is annexed to the land, and considered part and parcel of it. But it may be severed from the land by grant, condemnation or prescription. (Gould v. Stafford, 91 Cal., 146.)

An analysis and comparison of the various statutes cannot fail to reveal interesting points.

AGRICULTURE.

ORCHARD GRASS.

Orchard grass is one of the oldest and most valuable of the many pasture and hay varieties. It is ready to cut about three weeks earlier than timothy and supplies pasture throughout the fall and winter months. When sown alone this grass produces two to four tons of fine hay, and will yield one third more if mixed with red clover. It grows to perfection in every section of our country and is little injured by drouth or cold weather. All farm animals eat it with a relish, both in the pasture and hay stock. For the general stock farm, dairy or special agriculture it is an ideal and profitable plant.

The grass is especially beneficial to the special farmer because it is adapted to every soil characteristic. It does well on moist and shady lands and in porous subsoils, as the roots penetrate to a great depth. The drouth resisting qualities make it desirable for sowing on uplands where other pastures will burn out during the hot summer months. Like all others this grass consumes much plant food and the soil should be enriched by applications of potash and phosphoric acid. Nitrogen can be replenished by pasturing but the other foods must come from judicious fertilizing. Orchard grass, like all other crops, requires plant food for a full growth A good mixture for orchard grass would be 400 pounds of ground bone and 150 pounds muriate of potash per acre, thoroughly mixed with the soil before seeding time.

Orchard grass is sometimes sold as rough cocksfoot and is known among the botanical students as dactylis glomerata. It weighs 14 pounds to the bushel and requires from three to four bushels of seed to the acre. If mixed with redtop it makes a good bottom land hay and pasture and when some alsike or red clover is added to the mixture, it will do well for upland planting. The seed should be sown in early fall so as to get a start before winter or else put in the first thing in the spring. In the south this grass will start up in February, give a good hay crop in April and in case of dry weather die down in July and August, then come out again in the fall and give green feed all winter. If pastured very short it will come out again in a few days and furnish fine pasture,

The land should be well prepared for sowing to orchard grass, by close plowing and harrowing in order to make it level and well pulverized. Broadcasting is probably the better way to sow, as the seed is small and filled with more or less chaff. It is often mixed with perennial rye and other similar seeds and should therefore be purchased of none but the best seedsmen. They who make a business of supplying choice seeds have their names and reputation at stake and will seldom intentionally injure their business by palming off some old and mixed seed. It is a safe plan to deal with the best men and pay the highest prices for choice seed to prevent any waste of time and money on that which will be of no value.

The grass makes the best hay if cut early in the flowering period, as the longer it stands after this the tougher and more woody the stalks become. If permitted to ripen the stems are wiry and not so nutritious as when in blossom. The blades are flat and juicy and of a rich dark green color, which is maintained after harvesting, if cut at the right time. Mixing with timothy or late grasses spoils the good feed of orchard grass as it ripens before those are ready for cutting. The grass has a tendency to grow in tufts and

is much relished in this manner by the sheep and cows. It cannot be made into a neat and attractive lawn grass because of this feature.

Stockmen who have tested the various grasses for forage and pasture place them in a list as follows: orchard, timothy, redtop, Kentucky blue grass and bromus inermis. First of all in earliness, drouth resisting and productiveness is the orchard grass. It is also the king of winter pasture grasses. Stock do not bloat on this grass and it is never destroyed by over pasturing, unless stock are penned on the fields and kept there for feed yards. Those who have never tried this grass should plant a few acres and learn of its real merits. It may be sown alone or with a nurse crop and will be ready to cut the following season. The seed costs about 15 to 20 cents a pound, or less when 100 pounds or more are purchased.

JOEL SHOMAKER.

KENTUCKY BLUE GRASS.

Grass composes one sixth of the whole vegatable kingdom, and is the foundation of wealth and successful agriculture. Of the 800 cultivated varieties there is probably none more generally planted than the Kentucky blue grass. This is one of the oldest and most popular, as it furnishes feed almost the entire year for sheep, cattle and horses, and is suited for permanent pastures, hay meadows and lawns. It forms a thick turf, and is seldom injured by anything but the long summer drouths. The grass is very productive, unusally early and exceedingly late. Horses will dig up the snows of midwinter to find this luscious grass.

Kentucky blue grass is known under various names, as June grass, smooth stalked meadow grass, green meadow grass and spear grass. The plants are identical and one seed, if genuine, will produce the true blue grass just as well as the other. The botanists call this grass poa pretensis. It is a perennial and grows to a height of ten to fifteen inches. The flowering season is about the middle of June, or some time during that month. It produces only one long flowering stem and this is filled with seed. As a hay grass it is not so valuable as others on account of not producing so many tons to the acre, although the quality is the very best, and the hay sells for good prices.

The soil for Kentucky blue grass varies according to localities. Moist meadows are choice locations for growing this grass and so are hillsides, tablelands and other places where there is plenty of rain or abundant sub-surface moisture. It will not give good crops on the poor, clay hills, or where the land is very dry and subject to extreme drouth. The land should be put in fine condition by plowing and pulverizing before sowing the seed. After the land has been put in good condition it should receive about 100 pounds muriates of potash and 400 pounds ground bone per acre. A top dressing of nitrate of soda of say from 50 to 75 pounds would also greatly promote the growth of the grass.

Blue grass weighs 14 pounds to the bushel,and is generally sown at the rate of three bushels to the acre. The seed sells for $1.50 to $2.00 a bushel, and can be purchased of every seedsman in the country. Some farmers plant a small lawn or orchard to this grass and save the seed for future field sowing. The seed can be best harvested by using a hand stripper, or tin fronted box, made for the purpose. This is nothing more than a box made like a dip net, with a tin front having saw teeth cut in small niches. It is pulled up through the ripened grass, and collects the seed in the box leaving the stems standing. Any man can make one in a few minutes and thus collect plenty of seed from the lawn.

The grass should be cut just as the seed begins to ripen, if wanted for hay. If the mower does not leave it laying very thinly

on the ground then it should be thinned with a fork, so that the curing may be done as soon as possible. Hay ought to be put up without rain or dew falling on it, and kept in good shelter. It is short, compact and nutritious and does not require so great a quantity in feeding as does timothy or other grasses. Many prefer to make a mixture of two or three kinds in order to secure a more perfect and satisfactory ration of forage. If fed in a close barn with suitable floors much of the seed will be saved and can be sown in the chaff the next spring.

Mixed grasses, for both permanent pasture and hay meadows, are very desirable, and for lawns are most beautiful. For this purpose the blue grass is without exception one of the finest grown. It has the nice green turf of spring and the beautiful carpet of Christmas to present, while the other grasses have the volume of hay for value. By getting a good mixture, such as is presented by the experience of many years, from such seedsmen as Henderson, Salzer and others, the greatest value of blue grass is obtained. It is worthy investigating and giving a fair trial by all. JOEL SHOMAKER.

ALFALFA EXPERIENCES.

During the winter of 1902 a list of between 600 and 700 successful alfalfa raisers in Nebraska was collected, and to each was sent a report blank calling for a definite statement regarding a number of the processes he employed in obtaining his stand of alfalfa, and also regarding his subsequent care of the crop. More than five hundred satisfactory replies were received, representing eighty counties in the state. A study of this large number of reports from successful alfalfa raisers gives some valuable information respecting alfalfa culture.

There were 288 stands reported upon upland, and 273 upon bottom land. Even in the western portion of the state the amount of alfalfa on the upland is shown to be considerable, and very satisfactory results are evidently obtained, although naturally the yields of hay are smaller than on the bottom lands of that region. In the eastern part of the state somewhat heavier yields appear to be obtained from bottom land, but loss from winter killing or other causes is greater. Twenty-three reports state that upland is more satisfactory than bottom land. These come principally from the eastern portion of the state or the irrigated land of the western portion.

An astonishing feature of the replies is the large amount of alfalfa that they show to be growing on land with a clay subsoil. Sandy clay, clay loam, clay lime, etc., were not counted as clay. In spite of this limitation, 245 clay or gumbo subsoils are reported. A clay or even a gumbo subsoil does not appear to be a barrier to successful alfalfa culture.

The seed bed was prepared by plowing and further working in 373 cases, and by disking or cultivating in 75. Among the latter is one method that appears to be popular and satisfactory. This consists in thoroughly disking corn land after all trash has been removed from the field. In the western part of the state there are a number of good stands of alfalfa obtained by breaking prairie sod, disking it, and harrowing in the seed, also by disking the unbroken sod and harrowing in the seed. The latter commends itself as an easy way of supplementing the native grasses in pastures. The tendency to dispense with plowing on unirrigated land increases with the distance westward from the Missouri.

A study of the dates of sowing alfalfa seed in the spring shows a range from early March to late June, although where advice was volunteered it was practically unanimous in favor of early sowing. There were only eight reports of summer or fall sowing, of which one was sown in July,

four in August and three in September. In 108 cases a nurse crop was used, while in 393 cases the alfalfa seed was sown without that of any other crop. The use of the nurse crop was largely confined to extreme eastern Nebraska and the irrigated land of the west. Many persons who used a nurse crop say that they would not do so again. It has been recommended to use a light seeding of small grain, sown earlier or with the alfalfa, to prevent damage by severe winds. When sown in this way the nurse crop is mown when eight or ten inches high, to prevent it smothering the alfalfa.

In 55 cases the seed was put in with a drill and in 447 cases it was sown broadcast. This is at least an indication that if a drill is not available a satisfactory stand can be obtained by broadcasting and harrowing in, provided the other conditions are favorable.

There were 138 reports of less than twenty pounds of seed per acre being used, and 336 reports of twenty pounds or more being sown. The evidence seems to be in favor of the use of at least twenty pounds of seed per acre.

Of the persons replying to the inquiries, 221 have stands of alfalfa that yield more than four tons of cured hay per acre each season, while 157 do not get as much as four tons of hay per acre.

Of persons having practiced disking alfalfa in the spring or at other times, 138 report that beneficial results have been obtained, while 7 report that disking has been ineffective or injurious. By disking alfalfa is meant going over it in the spring with a disk harrow before growth starts or during summer immediately after cutting for hay. It is customary to set the disks at a slight angle. This cuts the crown root and stirs the soil. Some of the correspondents prefer harrowing to disking. Where positive objection is made to disking it was based on the claim that it caused the crowns to become diseased. The great bulk of the evidence was, however, in favor of disking.

Of the persons who have manured alfalfa, either by plowing in the manure immediately before seeding or by spreading it on the field after a stand had been obtained 110 obtained beneficial results, and 13 found it to be ineffective or injurious. Objections are based on the claim that plowing in manure causes the soil to dry out, but the objections to spreading manure on alfalfa are rather indefinite in their nature except that on low land it makes the growth too rank and the alfalfa falls down. Many of those who advocate its use specify that the manure should be rotted and fine. One man suggests harrowing after spreading, to fine it. The reports of beneficial results from plowing under manure come largely from the eastern portion of the state, but the use of fine manure applied as a top dressing has proven beneficial in all parts. T. L. LYON *in Bulletin 16 University of Nebraska.*

THE CRANBERRY.

Strangely enough the habits of the popular cranberry are almost unknown to its admiring friends.

The berries are grown in bogs that cost from three hundred to five hundred dollars an acre. The soil in which they flourish is composed of peat and clean, sharp sand, the latter being absolutely essential to healthy growth.

The bush on which the berries appear grows about six inches high, and every year it puts out "runners" that, in turn, take root and form new bushes; so that, when a bog first becomes productive, five years from the time of its beginning, it is thickly covered with bushes.

This growth is accentuated by a system of *irrigation* that keeps the bog water-soaked, though not to such a degree as to cause anything like a liquid state. The irrigating plan is most useful as a protection against frost, for, when the grower

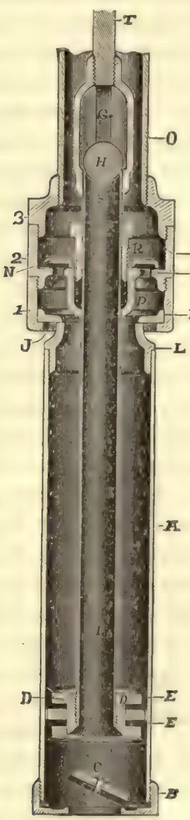
believes a frosty night at hand, he opens the flood gate and allows the water to overflow his bog, until it is from eighteen to twenty-four inches over bush and berry. The next morning the bog is drained and the fruit picked.

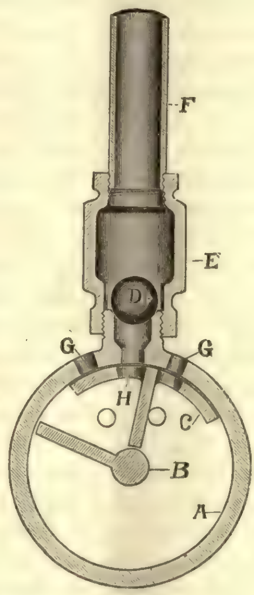
The picking process is a simple one. It consists of placing the fingers, slightly spread, beneath a bush, and then, by an upward movement, raking the bush clean of its fruit. By means of a winnowing machine the berries are freed from dirt and leaves. New York City alone consumes two hundred and fifty thousand bushels of cranberries every Christmas season.

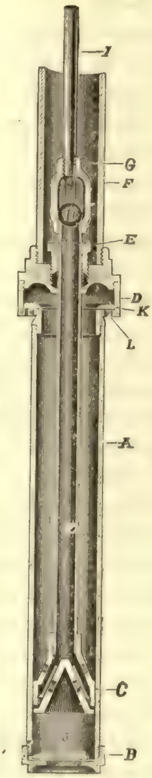
As the medicinal value of the cranberry is more generally recognized it is more eagerly sought by the epicurean world, and in 1901 over a million bushels were marketed as against half the number in 1900.

THE O. K. CISTERN PUMP.

In this issue we are showing illustrations of the O. K. Cistern Pump which is said to be one of the best double acting







submerged force pumps on the market. This pump is new in principle and parts from those heretofore known as double acting force pumps which doubles the quantity of water of any other pumps of the same capacity of cylinder and of less power. The patents covering this pump are offered for sale at a reasonable price to any individual or manufacturing concern.

The undersigned would like to get in correspondence with those who are looking for an article of this kind to place on the market. For further particulars address,

Wm. Scofield,
Care Irrigation Age,
Chicago

IRRIGATION.

RICE BY IRRIGATION.

The following notes on rice cultivation are furnished by Geo. J. McManus of Galveston, Texas:

What is there in rice growing for me?

Is it a sure crop?

Is it healthy?

How is rice raised? On a marsh, is it not?

Past attempts to answer such questions have proven futile because the truth is not credited when told.

Come with me to China or to any one of the bustling rice milling towns along the Southern Pacific railroad. It's a warm October day. It reminds you vividly of the hustling days of a big wheat crop in a Northwestern town. See the beautiful shock dotted rice fields coming up to the very edge of the village. Count the smoke of two, five, eight—no, fiteen threshing machines in sight. And here are seven long lines of wagons, heavily laden with sacked rice waiting their turn to unload at different rice mills or warehouses. Come to the roof of this building, and sweep the prairie roads with the glass in every direction. On each of them the incoming rice hauling teams are so near together as to appear a continuous procession. Now mingle wlth the people on the streets. You're an insensate soul, indeed, if you cannot feel the prosperity that permeates them! Does it not call you back to the dear old days of the early eighties way up in the Red River valley in Minnesota and Dakota, when we all were so busy?

Spend a month or more interviewing these farmers. Visit their farms. Cross question them within an inch of their lives. See the merchants. See the bankers, millers, farm implement dealers, rice buyers, doctors (if you can find them.) Inform yourself thoroughly about the whole rice situation (and you have heretofore been taken for a fool.) Now you may go back to conservative old chaps in the Northwest (as I have done) and tell it all to them. No, not all. Cut what you know to be average returns one third, so as to secure a respectful hearing—tell them:

1. The average farmer raises 200 acres of rice.

2. Tell them the average yield per acre is 11 barrels (44 bushels) rough rice as it comes from the thresher—162 pounds to the barrel. Very many planters make from 15 to 20 barrels per acre.

3. Tell them the price fluctuates from \$2.75 to \$3.50 per barrel, according to quality.

4. Allowing the farmer ordinary wages for himself and teams, it costs to raise \$5 per acre more than wheat or a total of \$14 per acre at most.

5. Tell them \$4,000 is the average clear profit of the average rice farmer on the average rice farm of 200 acres. Right here your reputation for truth and veracity will suffer a rent, which nothing will ever mend except a visit by every one of your hearers to the rice farms anywhere along the Southern Pacific from Crowley, La., to Eagle Lake, Texas. But you'd better tell it all.

6. Lands suitable for rice are smooth (not necessarily level), comparatively high and well drained—A marsh is not used for rice growing.

7. Fields are plowed with a gang or sulky plow, and cultivated thoroughly with a disc harrow, just as for wheat or oats. As good crops as any on new breaking.

8. One and one fourth bushels of seed per acre is used and is sowed any time from March to July. Good farmers use the best press drills for planting.

9. Levees or dykes are constructed with a plow and a V-shaped scraper on ines previously laid out by an engineer. These hold the water on the fields at an average depth of three inches.

10. When rice is 6 to 8 inches high it is flooded by fresh water by pump, canal or otherwise. Water is delivered at the highest point on the farm, and by little flood gates in the levees fills level after level between the levees till the whole farm is flooded at least three inches deep. It is kept so flooded for about 70 days.

11. An ample supply of fresh water, affording daily from one and a half million to two million gallons for 200 acres, is absolutely necessary for 60 to 70 days. This keeps the rice flooded three inches deep and makes up the daily loss from evaporation.

12. Irrigation is supplied by canals built upon the highest ridges of the prairie, from a fresh water bayou or river from which water is pumped into the canal. Or water is had from deep wells 8 inches in diameter and varying in depth from 135 to 200 feet. From one such well a 16 horse power engine can pump enough water for 200 acres.

13. When rice is ripe all water is drawn off, so that the land is as dry for harvesting, as in seeding—(One can't drain water from a marsh.)

14. Rice is cut with standard self binders, harvested, shocked, threshed just like wheat or oats.

ARID LANDS RECLAIMED.

Over 1,500,000 acres of land, once arid and classed as hopelessly sterile, have so far been reclaimed by irrigation in Nebraska. The work has reached such proportions that the state has established a bureau of irrigation and has a dozen experts employed during the summer superintending the distribution of water and reclamation of lands.

An intricate network of canals and ditches spreads out from either side of Platte River from its western entrance until almost half way across the state. In Scott's Bluff county, where it first enters, there are already nearly 350 miles of ditches carrying water to 340,000 acres. In Cheyenne county, next east, there are 246 miles of ditches, feeding 96,500 acres; in Deuel county, next east, there are 285 miles, giving life to 105,700 acres; in Lincoln county, immediately adjoining, there are 385 miles, watering 201,500 acres.

This reclaimed district is larger than the combined area of Rhode Island and Delaware, and it is estimated that between 60,000 and 70,000 people have found homes by this diversion of water, that formerly went to waste, to useful purposes. All this has been accomplished without a cent of aid from the government. Private capital alone has furnished the means, and although some of these enterprises, through over capitalization, have proven failures, the greater number of them are owned by the men whose farms are watered and who cheerfully stand for the proportionats assessments and conform to a reasonable set of rules governing the use of water.

State Engineer Dobson is preparing to carry on the work of reclamation on a much larger scale during this spring and summer. His present plans contemplate the temporary restraining of the spring floods of the Platte, and by this means he expects to add another 1,500,000 acres to the irrigated section. From July to October the Platte River is a river in name only. All of its meager flow is impounded by Colorado irrigationists long before the water reaches Nebraska, and to obviate the disadvantages arising from this condition, the engineers are planning a storage system. No permanent reservoirs are possible unless with government aid, but tem-

porary reservoirs are inexpensive and feasible.

Most of the canals and ditches in Nebraska are of primitive construction. Seepage has been the principal thing to guard against, as most of the carrying channels are mere ditches through the land and but a small number of sluices. In some localities there are artesian wells and in other sections deep wells with working pumps, but these form no actual part of the irrigation system.

Mr. Dobson figures that at least $10,000,000 yearly has been added to the products of the state. Much of the irrigated land is surrounded by an immense grazing country and the hay and feed raised thereon find a ready market, as well as adding to the value of the pastures by reason of the possibility of winter feeding of the stock. This value can be multiplied several times by intensive farming.

The one drawback to the spreading of irrigation has been the holding of the Supreme Court that the old common law riparian rights hold good in this state. This decrees that the owner of land adjacent to a stream has the right to the use of the running water there "undiluted, unpolluted and undiminished in quantity." As the mills were established long before the irrigation era, this gives to the mill-owner the right to prevent a farmer from diverting the water in any considerable quantity and restricts him to the ordinary usage of it.--*Farm Machinery.*

WATER-MADE DAMS.

Some of the old-time operations of the miners for placer gold and the use of the hydraulic "giant" have suggested an ingenious method of constructing dams for reservoirs in the West. The hydraulic giant was found to be a most effective and powerful agent in removing even compact bodies of earthern material. A stream of water brought from an elevation under great pressure and directed against the face of a hill in which gold was supposed to be tore its way into the mass with tremendous force, cutting out large amounts of the material and washing them away, the waste water assorting the fine from the coarse particles. The sand and gravel thus washed away was carefully examined for the precious metal.

Of recent years hydraulic power has been employed to almost reverse this process. Engineers, appreciating the great transporting and assorting power of water used in this way, have availed themselves of it to build up instead of tear down the land, and by carefully guiding the material loosened by the force of the water they have been able to accumulate and arrange it almost at will. The process has been found especially useful in the construction of dams. For example, if an earth dam is to be built, the material rolled along by the water is carried in flumes to the selected spot. On leaving the flume small boulders and coarse gravel are at once deposited. The sand flows on farther, and the fine mud is carried in suspension for considerable distances. It is thus possible to deposit the gravel on the outer slope of the dam and the finer material in the center, thus making a central impervious clay wall and heavy coating of coarser gravel on the upper and lower faces of the dam. The material being deposited under water is thoroughly compacted, and there is less danger of settlemant or of porous layers being formed than in the case of dirt placed by carts or scrapers. A number of dams, notably in Southern California and in Texas, have been built with extraordinary speed and small expense in this way, and even high railroad embankments have been constructed in like manner.

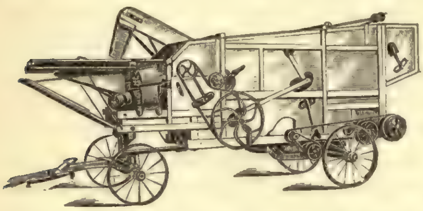
This method of construction of dams is being made the subject of study by the Division of Hydrography of the U. S. Geological Survey, in connection with investigations as to the feasibility of reclaiming the arid lands of the West.

A GOOD OUTFIT.

The following are among the many letters received by the Aultman-Taylor Company in praise of their outfits:

DALLIS, TEX., Sept. 30, 1901.

Gentlemen:—I have been running traction engines and rice threshers for several years in Texas and Louisiana and can say the "Aultman-Taylor" outfit you sold to Dr. W. W. Bouldin is doing first-class work



RICE THRESHER.

in every particular. The engine is an easy steamer and good puller on the road, and the Columbia Separator is a "hummer," doing fast and clean work, and does not crack the rice. In my opinion there is no better machinery made.

Yours truly,
J. M. LOVE.

RAYWOOD, TEX., Dec. 24, 1901.

Dear Sirs:—The threshing machine purchased of you last fall proved a fine success in the rice field. We threshed at the rate of one sack in 45 seconds. One of the most successful rice growers said it was the best job of threshing he ever had done; cleaned it better and broke the rice very little. The workings of the engine was the admiration of the engineer.

Yours truly,
C. W. CARDIFF.

*THE MINERS' INCH.

A series of 235 observations was recently made in the hydraulic laboratory of McGill university, with a view to a determination of "the miners' inch." The records will be very useful in the mining regions of Canada, as furnishing data for delivering water at mines. The "miners' inch" of water, it may be explained, is an arbitrary measure adopted for selling water in mining districts, and is defined as the amount of water discharged by an orifice one inch square (or the equivalent fraction of a larger orifice), with a head of from six inches to nine inches. The variation in the head makes the definition rather vague. In British Columbia it is defined as being 1.68 cubic feet of water per minute, or that quantity of water which will pass through an orifice one-half inch wide, two inches high and two inches thick, with a constant head of seven inches above the top of the orifice, and every additional inch shall mean so much as will pass through the said orifice extended horizontally half an inch. Mr. Drummond points out that, as a definition, this is completely wrong. In the first place, widening the orifice changes the coefficient of discharge, and therefore the discharge itself. In the second place, this orifice actually discharges 2.147 cubic feet of water per minute instead of 1.68 cubic feet, and this brings out a curious point, that certain shaped orifices with a thickness of two inches run full like a short tube, the vein is not contracted, and they actually give a greater discharge than they are supposed to give. The shape of the orifice has a perceptible effect upon the discharge. Circular orifices give the least discharge, rectangular orifices the greatest, and square orifices are intermediate. As the rectangular orifices become thinner, the width being the same, it will discharge proportionately more water. A one-inch by two inch orifice, two inches thick, is just on the margin between flow with contraction and full bore. If fixed in the vertical position, with longest diameter vertical, the vein contracts. If fixed in the horizontal position, with the longest diameter horizontal, it will also contract, but if rubbed with the fingers on the edge it will run full for a time and then contract again. If kept running full in this way it will discharge about one cubic foot of water per minute more than when full contraction

*From a paper read at a meeting of the Canadian Society of Civil Engineers by T. Drummond.

takes place. Mr. Drummond's measurements lead him to the following conclusions: "There are difficulties in the way of delivering absolutely exact quantities of water, and these quantities cannot bo measured out as a pound of tea is weighed over the counter. The definition of the module or unit, however, should be correct within reasonable limit of error. If it is a definition of a single miner's inch from an orifice of one square inch, it should go no farther. If the inch is defined as being some practical part of the discharge from a larger orifice, it should go no farther than the capacity of that orifice, and, as it is an unknown quantity to the outside world, the discharge should be given in cubic feet per minute. Convenient discharges are 1¼ and two cubic feet. The flow under low heads is irregular. Heads of one foot or more are not convenient, because the water is delivered from ditches or flumes, where the depth of water is never great. The question thus resolves itself into a choice of a standard module or unit from a flow under two conditions: 1. With a low head of 6¼ inches above the center of the orifice, giving a discharge of 1½ cubic feet per minute, with the advantage that it is already partially recognized as the miner's inch, and with the disadvantage that the flow is irregular. 2. With a head of 11½ inches above the center of the orifice, and a discharge of two cubic feet per minute, the flow being much more irregular, but the quantity being discharged now to the people." Definitions of both inches are given, but the author favors the last.

Definition No. 1 of Miner's Inch.—The water taken into a ditch or sluice shall be measured at the ditch or sluice head. It shall be taken from the main ditch, flume or canal through a box or reservoir arranged at the side. The orifice shall be fixed vertically at right angles to the delivering water-way and the edges and corners shall be sharp. The vein shall be fully contracted. The distance between the sides and bottom of the orifice and the sides and bottom of the waterway shall be at least three times the dimensions of the orifice. The orifice shall discharge freely into air.

No. 2.—One miner's inch of water shall mean one-quarter of the quantity which will discharge through an orifice two inches wide and two inches thick, made in a two-inch plank, planed and made smooth. The water shall have a constant head of 7¼ inches above the center of the orifice. It shall mean a discharge of 1½ cubic feet per minute.

WILL ADD TO THE WEALTH.

If the amended irrigation bill, now under consideration, becomes a law, a start will have been made in the task of reclaiming the vast arid territory in the western part of the country. The lands in question will support an immense population, add greatly to the wealth and productive resources of the country, and afford a market for a large quantity of manufactured goods.

FIELD NOTES.

Received from the Green River Oil Fields, Utah, May 3rd, 1902.

The Milton Oil company is on the active list; contracts let for sinking from one to ten wells.

The Huntington Oil and Mining Co. has just been incorporated to develop its land in these fields.

An Idaho company is erecting camp buildings preparatory to putting down a well near the San Rafael.

The Gold Dividend Oil Co. of Salt Lake City has been incorporated to develop their holdings in this field.

It is reported that R. H. Pope and associates will build and operate a refinery at Thompson's Springs this summer.

Samuel Maceachen has en route from Pennsylvania five Standard and two Star rigs to commence active work in these fields.

The California-Utah Oil Co. have let a contract for another 1,000 feet. The predictions are that this company will soon bring in a big well.

Now that silver has dropped to 50 cents an ounce mining men are turning their attention and money to the oil fields, as they promise better and quicker returns than mining investments.

The *Mining Review* of Salt Lake City, in its issue of April 30th, published a very able article on the "Utah Oil Fields" by Marcus E. Jones, A. M. It is a good thing; write them for a copy.

E. C. Gamble, an oil expert who has operated successfully in other fields, is here with a large corps of engineers getting ready for work. He expresses great faith in the outcome of the Utah fields.

Representatives of at least 500 companies and individual land owners are scheduled to meet at Price on the 8th for the purpose of discussing topics pertaining to our oil industry and to further its best interests.

An oil convention is to be held at Price, Utah, on May 8th. Object: "We believe that in Eastern Utah a much richer oil belt exists than any heretofore discovered. Hence there should be concentrated action in advertising our oil lands." A large attendance is anticipated.

The *Petroleum Gazette*, one of the largest and most powerful papers published in the Eastern oil fields, in a late number was kind enough to publish a two-column article about our fields. *Bonds and Mortgages*, published in Chicago, has also given our field considerable deserved space. Good things will come to the surface.

Encouraging reports continue to arrive from the Northwestern Consolidated Oil Co., who will soon have a rig on the ground. The California-Utah Oil Co. struck a flow of oil and water, which is now being cased off. Everything is going along nicely at the San Rafael and R. M. Pope wells. Companies are being formed, and everybody is getting ready to develop his ground.

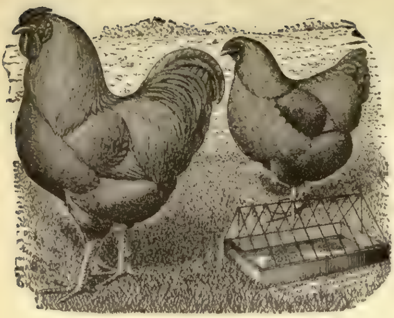
There has been considerable activity during the week. Many visitors have been here, among them several Denver parties who have been looking the ground over for capitalists, with a view of putting in several rigs right away. Rumor has it, and pretty well defined, too, that some of the rigs will be placed on Walker Bros'. ground. The parties in question returned to Denver with maps, samples of oil, etc., to make final arrangements with the capitalists referred to, who are all operators at Beaumont, Tex.

While en route to Boston Manager A. J. Davis stopped off at Cincinnati to confer with the officers of the Cincinnati, Utah & Wyoming Oil Co. So well pleased were the Ohio people with the report made by Mr. Davis that they decided to com-

mence active exploitation work on their property in the Green River oil fields immediately. Mr. Davis closed a deal in Boston upon his arrival there of 37 sections of oil land in the Green River oil fields at the price of $5 per acre cash. Mr. Davis has now en route two more Standard rigs for these fields.

Will be pleased to hear from you at any time; will send you oil samples and full information.

S. L. Boggs,
Salt Lake City, Utah.



Golden Buff Wyandottes.

After eight years' continuous breeding, mating and perfecting this most popular and profitable variety, I have my yards free from disqualifying points, they are all Buff to the skin, and are from first prize winners of four of the best strains. The following is what Judge Theo. Hewes says of the Buff Wyandotte:

"I have no desire to boom this breed to the detriment of others, but I can surely give them a strong endorsement. After six years breeding them, I am free to say that I do not know of a single variety that would be a better investment for the amateur just starting, one who wants to handle one variety, and does not feel like taking up some of the older breeds where there is so much competition, than the Buff Wyandotte. Neither do I know of a variety that would make a better cross on common fowls to increase the egg yield."

My matings for 1902 are the best I ever had and will offer a limited number of settings of eggs after February 20th.

First yard, $2.00 for 13; $3.50 for 26.

Second yard, $1.50 for 13; $2.50 for 26.

Cash, P. O. or express order must accompany all orders.

For 25 cents I will send you a receipt for destroying all lice in poultry, pheasants, pigeons and dog houses. The druggist fills sample order for 10 cents. All you have to do is to tie bottle to nail in poultry-house, remove the cork and the fumes will do the rest.

F. E. SHORT,

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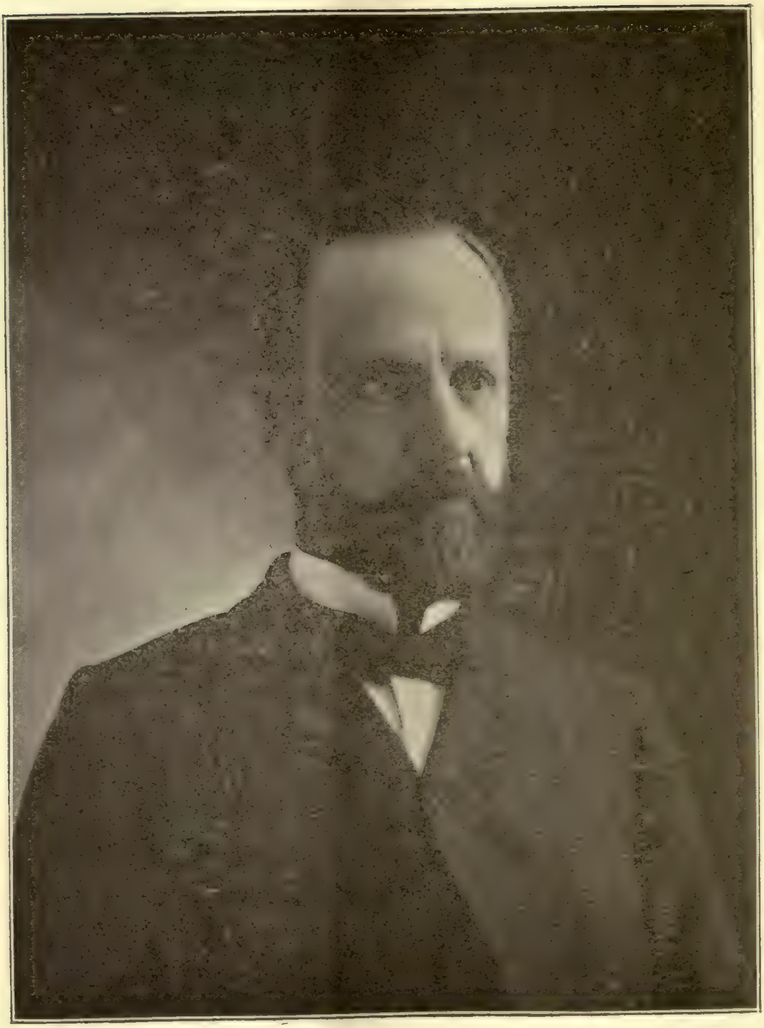

H. W. CAMPBELL, Holdredge, Neb.

THE IRRIGATION AGE.

VOL. XVII. CHICAGO, JUNE, 1902. NO. 6

THE IRRIGATION AGE.

D. H. ANDERSON PUBLISHING CO.,
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A monthly illustrated magazine recognized throughout the world as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world, and has no rival in half a continent. It advocates the mineral development and the industrial growth of the West.

D. H. ANDERSON, - - Editor.

H. W. Campbell. We present as a frontispiece in this issue a portrait of Mr. H. W. Campbell, of Holdredge, Neb. Mr. Campbell is known the country over from his extensive experiments in soil culture under the title of the Campbell Method. He has devoted a great deal of energy and time in exploiting his ideas, and it affords his friends much pleasure to know that his system has proved successful, and that he may reap some of the benefits during his lifetime. Mr. Campbell will contribute a series of articles for the columns of THE IRRIGATION AGE, the first article to appear in our issue of July.

The List Growing We are pleased to be able to report a decided increase in the circulation of the AGE. Within the past six weeks 630 names were added to our subscription list, which we trust will reach the 25,000 mark by January, 1903.

Help for the Arid West. Government aid in the reclamation of arid lands is now assured, the irrigation bill having passed the house June 13 by a vote of 146 to 55. It took two days of stubborn fighting to achieve this victory, although the President had several times expressed his approval of the measure.

The bill creates a reclamation fund from the sale of public lands in Arizona, Colorado, California, Idaho, Kansas, Nebraska, Montana, New Mexico, Nevada, North and South Dakota, Oregon, Utah, Washington, Wyoming and Oklahoma. This fund, less the amount paid to local land offices and 5 per cent due the state for educational purposes, is to be used for building and maintaining irrigation works in the states and territories named. Provision is made for limiting the sale of lands to bona fide set-

tlers, and not more than 100 acres shall go to any person in one tract.

As passed the bill provides for the payment out of the treasury of any deficiencies in the allowances to agricultural colleges owing to the disposition of public lands. The Secretary of the Interior is authorized to examine, survey and construct the irrigation works and report the cost thereof to Congress at each session.

Mr. Burkett, of Nebraska, and Mr. Newlands, of Nevada, were ardent champions of the measure, while Messrs. Grosvenor, Robinson, Dalzell and others made speeches in opposition. Grosvenor argued that it would make existing railroad land grants worth four times the present value and would also affect present farm land values. Mr. Hepburn, of Iowa, who spoke against the bill, claimed it discriminated unjustly against the eastern farmers, being a plan to secure government aid in the improvement of farm lands in certain states, while the farmers of other states were left to work out their own salvation. This is a small view to take of a great measure—a measure which will mean prosperity to thousands. One might as well oppose the building of the levees along the Mississippi, which protect the farmers and other dwellers from disastrous floods, on the ground that this work would not aid the dwellers in other sections, as to oppose the present measure. A man is short-sighted, indeed, who cannot see that prosperity in any one section of the country affects favorably all other portions. The drouth in certain states last year affected, not only the dwellers in the immediate vicinity and the farmers themselves, but the large dealers in the cities, and the affect would have been still more disastrous had there not been extremely prosperous seasons immediately preceding this. Suppose there is a drouth in Southern Illinois, what is the result? The farmer immediately curtails his expenses in every way possible, buying nothing but what is absolutely necessary, oftentimes being obliged to go in debt for that. The storekeeper in that vicinity is obliged to cut down his orders for goods and tells the drummers who visit him from city wholesale houses that he "doesn't need" this or that, which in prosperous times he could easily dispose of. This cuts down the sales of the wholesalers, and in turn reacts upon the manufactures, and lastly it affects the laboring man of the city, provisions being dearer and work scarcer. It therefore follows that what is is beneficial to the farmer in the West will also be of benefit to the dweller in the East and the talk of discrimination is all nonsense.

Advertise. Now is the time to reach irrigation farmers through this publication which is the recognized authoity on that subject. Do not be led to believe that the ordinary agricultural publication covers this field. There is only one distinct irrigation publication in the world and that is THE IRRIGATION AGE. Write for rates.

Current History. The past few weeks have been history-making ones. Seldom, in so short a period of time, have so many important occurrences transpired of such a widely different character. The weary dove of peace has at last found a resting place and the entire civilized world rejoices that the bitter war, so long engaged in in South Africa, is ended. Burke Cochran says the surrender of the Boers reminds him of the bitter feud between an Irishman and a Scotchman. The former said he would give five dollars to make Sandy acknowledge he was beaten, whereupon the canny Scot said, "Put the siller in my hand, mon, an' I'll surrender. You can ha' a' th' glory if you'll gi' me th' consideration." England has the victory, but the Boers have gained many things for which they fought.

War in the Phillipines is also ended, and the bill providing for temporary government passed the Senate June 3. The

bill paves the way for a permanent popular representative government; for public works on a large scale; granting of franchises to develop resources of the islands, a coinage system; purchase of the friars' lands, and extends the bill of rights to natives, except in so far as it relates to the right to bear arms and the right of trial by jury.

While such important changes were taking place among the inhabitants of the globe, Nature herself took a hand in the history making, and her pyrotechnic feats at Martinique will go on record as the most disastrous volcanic eruption of modern times. Rains throughout the middle and western states have done considerable damage to growing crops and property, and occasioned some loss of life. Could this storm water which overflows rivers, causing death and destruction, be impounded in reservoirs near the rivers' sources what a blessing it would be. The recent strikes throughout the country have proven what a power the union has gained in almost all sections. While capital and labor have fought the public has been tossed like a ping pong ball from one to the other, being the most inconvenienced of anyone concerned. It is hoped the great coal miners' strike which affects so many industries, perhaps indirectly, may be wisely settled. The strike of the drivers for the meat-houses worked good to the small farmers near Chicago, many butchers deciding to buy stock of them in preference to risking a disturbance by buying from the wholesale dealers against whom the strikers were waging war.

The Manufacturers' Association. At the dinner of the Illinois Manufacturers' Association, held in Chicago, June 4, James Hill president of the Great Northern railroad, spoke on Commercial Expansion. He considered railways, he said, of next importance to agriculture in the interest of the country. "The development of commerce," said Mr. Hill, "is the effort by a country to find a market for its own productions or to supply itself with material for its necessities or to further increase its means of commercial expansion. The commercial expansion of a nation is the best index of its growth. Commercial growth is both domestic and foreign. In the past the public domain suited to the cultivation of the soil, producing every useful crop, has furnished homes for the multiplying population. To-day we have about reached the limit of our public domain which can be made to furnish homes for an intelligent and enterprising population."

Mr. Hill's remarks on irrigation were a strong argument for government aid in irrigation enterprises, for as, he said: "In a few limited communities of the West irrigation has been commenced by what may be called 'individual effort.' Owing to diverse laws, made to suit particular interests, the irrigation of large areas is attended by greater difficulties than can be well surmounted by individual effort."

Legislation which would give more uniform laws to irrigation districts and more financial assistance in constructing irrigation systems, would be the means of opening a vast territory to settlement.

Crop Conditions. Crop conditions throughout the country appear to be favorable. Travelers returning from the West report the general outlook as excellent. Eastern Washington, Oregon and Northern Idaho have enjoyed a rainfall of three inches which insures a wheat crop equal to last year. The monthly crop report from Missouri shows that there is an improvement over the previous month in all the principal crops except apples. The crops are generally above the average for this time of year. The recent heavy rainfalls, which caused floods in some sections, did considerable damage to crops in portions of Oklahoma, Colorado, Illinois

and Wisconsin. The condition of the cotton crop June 1 is reported, by the statistician of the department of agriculture, to be 95.1. Only twice within a period of twenty-one years has the average condition on June 1 been as high as at present. This was in 1887 and 1806, when the average condition of the crop was 96.9 and 97.2 respectively. About 72,000 acres less than last year are planted to cotton, making the acreage for the year 1902-03 about 27,450,000.

Dr. True's Visit. Dr. A. C. True, director of the Office of Experiment Stations, United States Department of Agriculture, visited Fresno, Cal., May 15, for the purpose of conferring with those prominently interested in irrigation and to view in a general way the district in which his office will engage this year in the preparation of a great drainage system. Elwood Mead, so well known in irrigation circles, is to have charge of the work in Fresno county. Soil conditions in that neighborhood will be studied with a view to solving the problem of preventing the accumulation of alkali in the soil through irrigation.

"It is clearly understood," said Dr. True, "that the work of the Office of Experiment Stations is intended to supplement, and not in any way to interfere, with the work already undertaken by the Bureau of Soils. We take up the whole drainage question and view it from the engineering standpoint. Though our plans may be incidentally related to the removal of alkali, such a system as that planned by us would be required even if the soil were free from alkali."

In his visit to the culture station at Tulare, Dr. True was much interested in the work there, which he found progressing splendidly. The culture stations report in each state to some central station. In California the supreme station is that at Berkeley and the culture stations are only part of a general scheme.

"At Tulare," said the doctor, "they are introducing the Turkestan alfalfa and observing what it will do and what can be done with it. There are some hundred varieties of grapes that are being tested. Some prove unable to stand the conditions, while others thrive. It is in this way that the culture stations are accomplishing good—in finding out what desirable plants will grow under conditions here and conditions there. Reports are made to the supreme station of the state and thence the information is disseminated to the public."

The Charleston Exposition. The Charleston Exposition closed May 31 and, as usual, the report is that it was not a paying investment to the stockholders. From a financial standpoint these expositions are rarely a success, but from a sociologic and economic one they are generally of far-reaching good. The one at Charleston was instrumental in calling to the attention of northern capitalists the resources and possibilities of the South, which will probably be developed.

New Postal Regulation. A bill was passed by the Senate June 4 providing that the postmaster-general may extend free delivery to cities of 5,000 inhabitants or $5,000 gross income, removing the present limitation to cities of 10,000 inhabitants.

IRRIGATION IN FIELD AND GARDEN.

By Professor E. J. Wickson.

(Reprinted from Farmers' Bulletin No. 138, issued by U. S. Dept. of Agriculture.

FLOODING IN CONTOUR CHECKS.

Preparing a field for flooding in contour checks consists in throwing up low levees approximately on contour lines, with cross levees at intervals to limit the area of the checks. This method is best suited to land of very gentle slope—land which the eye would judge to be nearly level. The main idea is to restrain the water with levees which will not prevent crossing with farm machinery, and which therefore should not be much more than one foot in height and usually less than that. The contour lines showing one foot differences in elevation must be some distance apart to leave inclosed areas large enough to make it worth while, and this can only happen on nearly level land. In order to cover the whole surface the levee on the lower line or side must always be a little higher than the difference in elevation between the bases of the two levees, because it is seldom a check can be made brimful, and unless that is done the water would not be set back to the base of the levee on the higher line.

On land with very much slope the checks would obviously be too small and the levees too high and expensive, and they would interfere too seriously with the operation of machinery to make the system practicable. On the other hand, for nearly level land to be put down permanently into grasses or clover, the contour-check method is constantly growing in favor, and has largely displaced the more elaborate rectangular-check system, which will be discussed later.

Contour checks were formerly used only in connection with lateral ditches leading down the slope in the line of greatest fall, and the levees were run each way from these ditches and the checks filled from gates or temporary openings in the sides of the ditches. This is still done, and is desirable in large fields suitably laid off by a surveyor. For smaller fields, however, and without professional assistance, the laterals can be largely dispensed with and the contour checks filled one from the other with very simple gates to control the flow of water.

It is very common in California to see quite large fields of alfalfa in which all the laying off and levee construction have been done by home skill and with farm teams and tools. The way is, in outline, as follows: Plow the whole field deeply and then begin at the highest point in the field at which water can be delivered by a supply ditch.

Use the triangle and run a level line each way from this point to the side of the field. Then return to the supply point and proceed, as described previously, to find a point at, say, one foot lower elevation. When that is done work both ways from the starting point until that line is carried to the sides of the field. If stakes rising about 18 inches from the surface have been used to mark the line, these will show the top of the levee to be constructed. When the whole field has been marked in this way, loose dirt is gathered up with team and scraper and placed along the levee lines. But only a slight skimming is taken, that the surface may be kept free from depressions. If there are knolls and hummocks, they are scraped off and put into the levees and more plowing done here and there as needed. On the sides of the field a continuous levee is made to hold the water where wanted. If the levees are very far apart and the checks, therefore, too large for the stream of water in use, they are reduced in size by running cross levees. After the scraper work is done the levee is shaped into a low, rounded form with hand tools, if the job is a small one, and then the whole field is harrowed lightly so as to even the slopes without dragging down the levees too much. If the dirt has been dumped to the top of 18-inch stakes, the harrowing and subsequent settling will reduce it quite as much as is admissible and still have it set water back to the upper levee a foot higher. On small work much less than a foot difference in elevation is often used and the levees are proportionally lower.

If the checks are to be filled from each other (Fig. 13), simple water gates are placed in the levees at such places and distances as one can best judge will facilitate the distribution of the water. These gates are simply boxes, each having a bottom and two sides, with slats across the top to hold the sides in place. About the middle and on the inside of each side two cleats are nailed just the right distance apart to admit the sliding board or gate to pass up and down between them. These gates are about a foot high and wide in small work, and larger if a large stream of water is available. Where cross levees are used to make smaller checks, more gates are placed in the highest levee, so as to allow the water to flow down in one direction and then in another until all the series have been filled.

Sometimes the contour-check system is used without gates by simply allowing the water to fill the higher checks and then flow over the levee into the next, and so on. In this case the levees are quite low and the checks are small.

As a rule the size of the check should depend upon the head or stream of water to be used, and all the appurtenances should be in proportion. The check should be of such size as to be quickly filled, else the lower side will be saturated and the upper side merely moist-

ened. This method of irrigation is largely used for alfalfa, and haying machinery is readily worked over the levees, which are, of course, covered with the plant as well as the bottoms of the checks. It is also used for grain growing, the levees being plowed, harrowed, and reaped just as are the inclosed spaces.

FLOODING IN RECTANGULAR CHECKS.

Flooding in rectangular checks has been largely superseded by the use of contour checks, except in orchard, vineyard, and garden work. Unless the land is very nearly on a level, much earth has to be shifted in making the rectangular inclosures, and the levees are of irregular heights, while levees on contour lines are practically uniform. There is, consequently, greater difficulty in passing machinery over them. For orchard and vineyard, where the rectangular arrangement of the trees and vines continually interferes with contour work, rectangular checks are widely used where the character of the soil calls for flooding.[1] They may be large, inclosing quite an area of vines or trees, or they may be very small, even but 10 feet square. This, of course, depends upon the grade of the land.

For the growth of garden truck, also, the rectangular arrangement accords with the rows in which such products are grown, and Fig. 14 represents a typical scene in a market garden operated on this system. In such cases the laying off is temporary, as when the crops are gathered, or at the end of the season's succession of crops, the levees are plowed down, and then the whole field thoroughly plowed and harrowed and the levee system restored, sometimes by backing furrows each way, and finishing with hand tools or by using a ridger, etc., pictured and described in a previous farmers' bulletin.[2]

In small gardens it may be thought better to retain the levee system and work the bottoms of the checks with fork or spade, according to the usual methods of hand-power gardening. In field work on level land the checks may be so large that teams are used inside the levees, and in that case the irrigation arrangements are permanent. Whether, however, the levees be temporary or permanent, the water is applied about the same way already described for the contour-check system.

In the most satisfactory work in rectangular checks the check bottoms are approximately leveled by scraping the hummocks into the low places, using surplus dirt for the levees. Grading or leveling is very desirable, and the initial cost is returned many times over in the ease and satisfaction with which the water is evenly distributed inside the check. This is often done by running small furrows between the plants in the check bottoms so that the water is led this way and that until all the plants are equally supplied.

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1 See U. S. Department of Agriculture, Farmers' Bulletin 116.

2 See U. S. Department of Agriculture, Farmers' Bulletin 116, pp. 30, 31.

(To be continued.)

SUGAR BEET EXPERIMENTS.

The Nebraska Experiment Station has just issued Bulletin No. 73, which gives the results of a number of experiments in sugar beets, by T. L. Lyon and A. T. Wiancko.

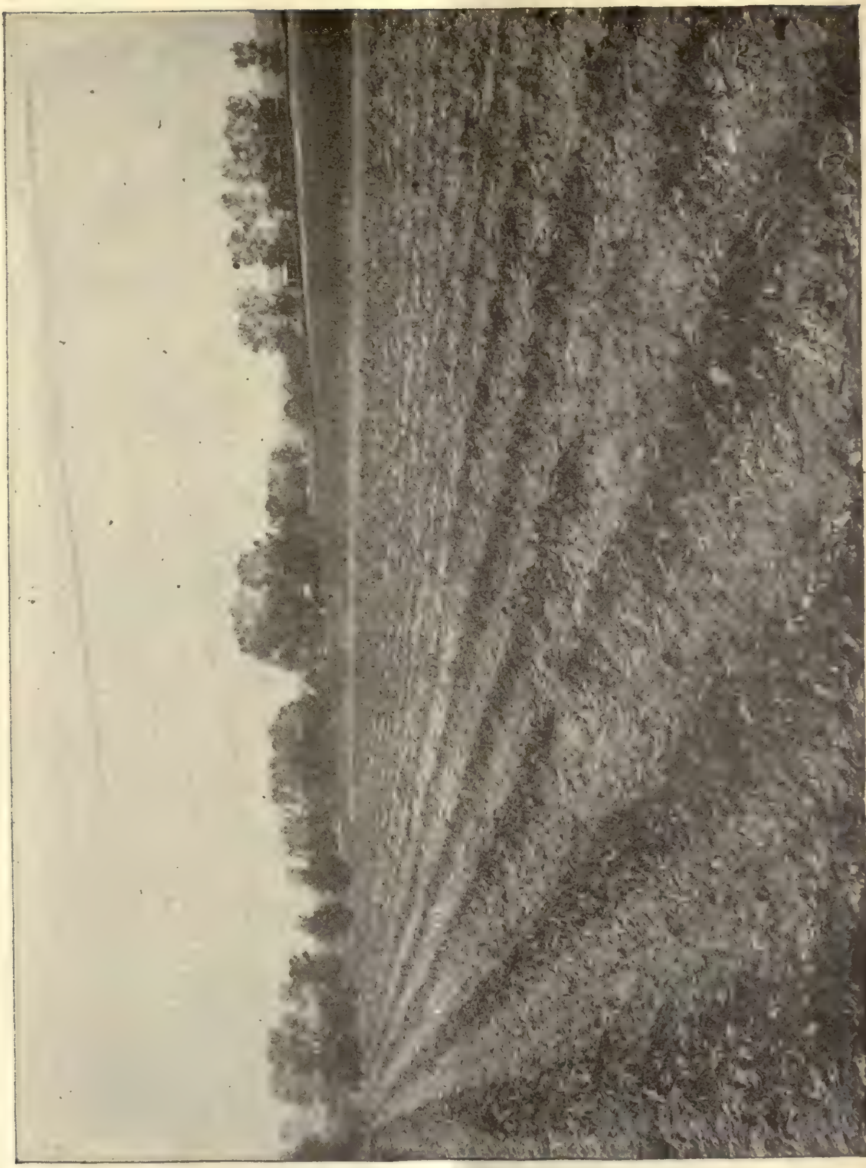
The experiments were conducted during the season of 1901 upon the farm of the Standard Cattle Company, at Ames, Dodge county, Neb., and included tests of varieties, tests of fertilizers, distance of planting, time of planting, methods of cultivation, and the treatment of sugar beet diseases.

Hand-hoeing sugar beets at Ames, Neb.

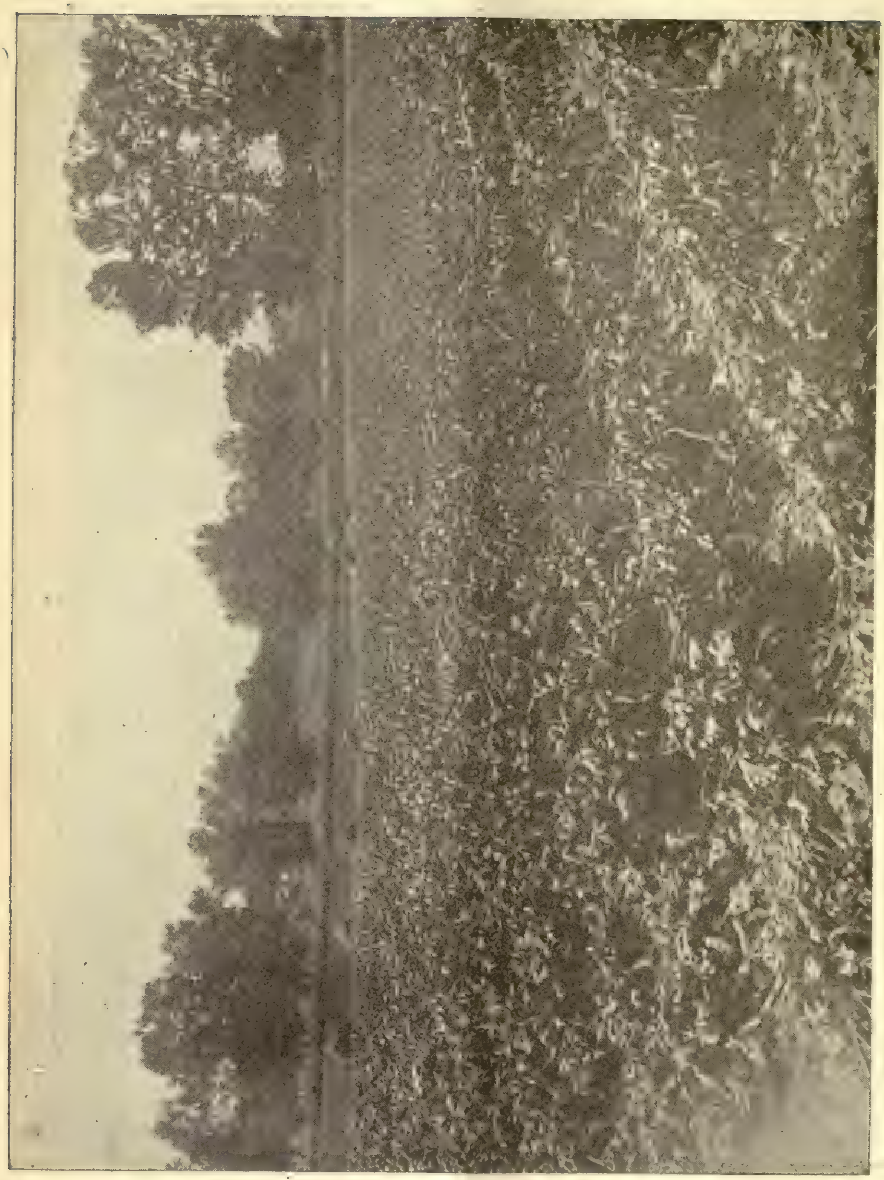
A test of 37 varieties under similar conditions showed a wide variation in the total amount of sugar produced per acre, the original Klein Wanzlebener occupying first place.

A comparison of light and heavy soils for sugar beet production showed a considerably higher sugar content in the beets grown upon the heavy soil.

Slight increases in the yield, sugar content, and purity of beets were produced by the use of commercial fertilizers, but their use did not seem to be profitable upon the land where the tests were made;



Beets grown the second year on the same land.



Beets grown on land cropped rotatively.

Of the different classes of fertilizers used the phosphate gave the best results.

Bulletin No. 67, by H. A. Nicholson and T. L. Lyon, contains the following in regard to the proper space between rows:

"The most satisfactory results have so far been obtained by having the space between the rows of beets 18 inches, with beets 8 inches apart in the row. This admits of horse cultivation and yet brings the plants sufficiently close together to prevent their growing too large. A plan that gave very satisfactory results was to allow 18 inches between every fourth row and 15 inches between the others. This plan admits of horse cultivation if a four-row seeder and cultivator are used. Beets planted in hills 18 by 8 inches apart produced a very poor yield per acre and a relatively low sugar content and purity. Beets grown in 12-inch rows were unsatisfactory on account of the necessarily expensive hand cultivation."

KIND OF CULTIVATION DESIRABLE.

"Experiments in 1899 and previous years have shown that shallow cultivation throughout the growing season is desirable. Deep cultivation dries out the soil to a greater depth and decreases the yield of beets. This is true both on heavy and light soil in Nebraska. Four to five inches is deep enough to cultivate and hoe the beets."

EFFECT OF WEEDY VS. CLEAN GROUND UPON SUGAR CONTENT.

On the assumption that the growth of weeds in sugar beet fields, aside from lessening the yields, may have a deleterious effect upon the sugar content of the beets, it was determined to make some tests with a view to ascertaining the extent of the injury.

Adjoining portions in two different fields were selected for the experiment. In each field a plat was allowed to run to weeds about the end of July and the beets from these were compared with samples taken from the adjoining clean ground. The tests were made during the first and second weeks of October and the samples consisted of five average-sized beets each.

Owing to the fact that both plats received the same treatment and were kept equally clean until late in the cultivation season, it may be assumed that the difference in the results obtained was not so marked as might otherwise have been the case. Nevertheless, the test plainly indicates that where weeds are allowed to flourish they may very materially reduce the value of the beets produced.

The fresh growth of the beets induced by the wet weather during September was found to result in a rapid reduction of the percentage sugar content of the beets, but the results of extensive determinations indicate that unless the fresh growth is accompanied by buds upon the crowns there seems to be no real loss of sugar—the beets

seem to increase in size and weight while the sugar remains at a standstill.

Surface applications of lime were effectively used in checking the Rhizoctonia rot of beets. Repeated spraying with "Bordeaux mixture" seemed to be of some value as a preventive of "leaf spot," but did not show any curative value upon diseased leaves.

The disease was, in most cases, first noticed and most destructive on land on which beets had been grown the previous year. The illustrations show two patches of beets in the same field. On one of these beets had been grown the previous year, and on the other soy beans had been raised. The two patches were about twenty rods apart. The beets on the first patch were very severely attacked by "leaf spot," while those on the second suffered very slightly from that cause. The photographs were both taken September 1, and serve to show how completely the beets on the infected patch were stripped of their leaves.

Never plant beets on the same land two years in succession.

The season's experience showed to a remarkable extent the drought-resistant qualities of sugar beets, in which respect they were found to be superior to any crop upon the farm except alfalfa.

BE CONTENTED.

Then let us, one and all, be contented with our lot;
The June is here this mornin' and the sun is shinin' hot.
O, let us fill our hearts up with the glory of the day,
And banish ev'ry doubt and care and sorrow fur away.
Whatever be our station, with Providence fer guide,
Sich fine circumstances ort to make us satisfied;
For the world is full of roses, and the roses full of dew,
And the dew is full of heavenly love that drips for me and you.

—James Whitcomb Riley.

RAISING ONIONS BY IRRIGATION.

BY I. T. C. NYE, OF LAREDO, TEXAS.

The following is in answer to your inquiry as to how I came to go into the irrigation business and also gives a short statement of my methods and success in onion growing.

In 1890 I bought a small ranch in La Salle county, six miles northeast of Cotulla, Texas. I kept steers principally on this ranch and I kept a hired man—a negro—who was a good farm hand, as well as a fairly good cow puncher, and we tried to do farming, but owing to the lack of rain we made but a poor success of the operation. Now at that time there was not a garden worth speaking of in the county and we very soon got tired of doing without vegetables. Time hung very heavily on my hands, so I concluded to lay a pipe from the stock cistern (which was kept full by a windmill pumping from a two hundred foot well) to the field 300 feet away; the colored man said that the point where we reached the field with the water was the poorest ground on the ranch, but economy compelled me to put the garden there. We had only an inch and a half pipe and not sufficient water for more than a plat of ground 50 feet square, but the garden stuff grew finely. The darkey had been accustomed to farming on Old Caney in Matagurda county, which is said to be the richest land in Texas, and our garden proved to be a great surprise to him as well as myself. This success on a small scale encouraged me to try and do a little more, and I had a well bored in the middle of the garden and the family were supplied with all the vegetables they wanted, and I sold about $200 worth a year besides. The well, windmill, well boring and horse-power pumping jack cost $700. I learned that there was something in growing onions by irrigation, for on 6,000 square feet of ground I grew 2,800 pounds of Bermuda onions and sold them f. o. b. Cotulla for $70.

Late in 1897 I sold the ranch, and after studying what I should go into, finally concluded to go where there was plenty of water and buy an irrigated farm, so I came here and found my present place, which is situated on the bank of the Rio Grande, five miles north of Laredo, lying along the I. & G. N. railway, with a flag station on the place. I purchased 100 acres of land, a residence, all necessary outbuildings, and pumping plant complete, with a capacity of 50,000 gallons of water per hour for which I paid $7,000, and after four years' experience $15,000 could not buy it today.

At first I planted onion seed for a stand on four acres or more and

thinned them later on, transplanting the best of the thinners. My first crop, four acres, planted October 1, 1898, and maturing April 15, was 65,000 pounds. The crop planted in October, 1899, was almost a failure, six acres producing 54,000 pounds. The failure was caused by too much rain falling right on top of the irrigation. Still the crop brought $850. With the next crop, planted Oct. 1; 1900, I woke up to the fact that it was bettér and cheaper to plant the seed in a seed-bed and at two months transplant the whole thing. The yield turned out 21,000 pounds per acre or 147,000 pounds on seven acres; which sold at 2¼ cents per pound f. o. b. here. Some land not fertilized yielded only 10,000 pounds per acre, but fortunately there was but one acre of such poor quality, and another piece of new land, but without fertilizer, yielded 20,000 pounds per acre, and some land that has been fairly well fertilized yielded 31,500 pounds per acre. This last yield at price sold at—2¼ cents—brought $708 per acre, quite a difference in favor of the use of fertilizers. I am, therefore, a first-class crank on fertilization.

The Bermuda onion is the only variety that has proved a success here. No northern variety will succeed at all here. I have tried them all; the Bermuda matures in 200 days, other varieties require from 220 to 270 days. Onions here, to prove a success, must be developed before the extreme heat of May and June comes on, otherwise they won't keep, and will be more or less rotten in the field. Prices, too, are always better in April and May. We have an ideal onion county; never cold enough to injure them at all, hardly any rain, and a very dry climate 400 feet above sea level.

I make a specialty of onions, as they are the only crop that can be grown through the winter. If cabbage is at exactly the right stage when the cold comes, it can stand it, but if not, it will surely be killed or seriously injured. This was the case in December last. The first planted came through all right, but the later planted was killed, and there was not a frost since December 15. Onions were not hurt at all. Besides onions, I raise both sweet and Irish potatoes, grapes, muscats, cantaloupes, and vegetables of any kind except beans, for all of which we have a fairly good local market.

There are a great many beef steers fed on cotton meal and hulls in Texas, and the best manure is obtained from these feed lots. Sixty tons per acre is not too much if put on four or five months before planting time, and irrigated so that it will be leached to some extent before onion planting time in December. All farm journals, in giving the farmers advice as to how to use fertilizers, tell us to apply so much well-rotted manure, but I want it to leach and rot in the ground where the crop is to grow. Sixty tons of manure on an acre is sufficient, in my opinion, for two and perhaps three years.

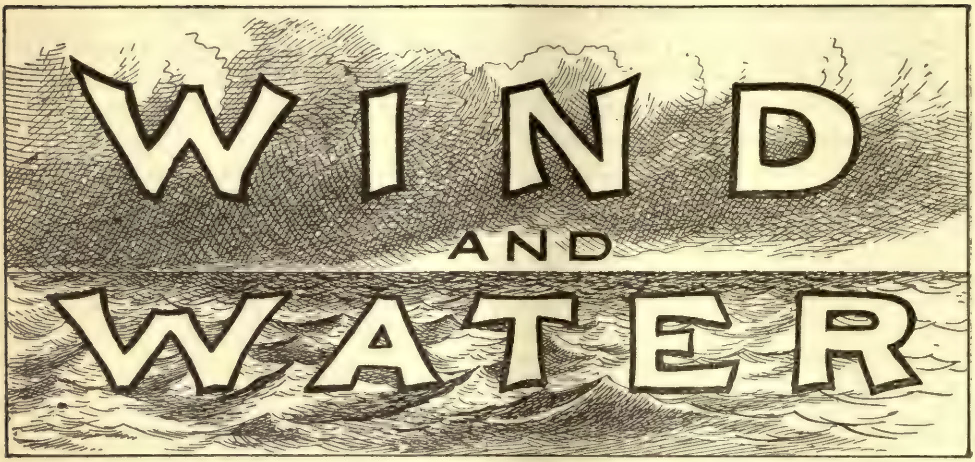
Rocky Ford cantaloupes do nicely here when there is no rain. I got $500 out of an acre and a half last summer, but when there is lots of rain the cophiz destroys them. Irrigation will produce a splendid plant growth, but is not so successful in growing insects and bugs.

People looking at my present onion patch say, "What a nice stand you have." When I dug up the plants in December I had them carefully sorted and only replanted those of uniform size, so each one would have an equal show, one with the other. I generally put about 80,000 plants on an acre. My land being alluvial without a clay subsoil I am compelled to use the flooding system to irrigate. Beds are 12 feet by 150, with a border between each bed, consequently the border wastes at least two rows per each border, so when the outside measure of an acre is taken there is really not an acre in it. The rows are 14 inches apart and plants from 5 to 6 inches in the drill.

These Bermuda onion seed are grown in the Canary Islands. We plant as soon as they arrive, which is generally about October 1, and transplant at the age of two months. By the middle of April they are mature and ready for shipment. One advantage we have here in growing onions, and it is no small one either, is that in growing them in the winter months we hadly ever have to weed the rows, the Planet, Jr., cultivators keeping everything down between the rows. By the time the weeds come the plants are so large and strong that the weeds and grass in the row make little showing, so we save that expense. But the greatest advantage of all is the time at which our's mature. The onions on hand in April and May were matured in September, and as soon as they come out of the cellars and strike warmer air, go to sprouting, and are no longer of any value, and there are no onions to compete with our. Competition is a fine thing for the consumer, but very thin for the producer.

The Bermuda onion crop was generally killed out in Texas in December by the cold weather, except here and at Cotulla, which is 65 miles north. They are grown there by irrigation same as here, and I don't believe that they can be successfully grown in any part of Texas without irrigation. The month of October, which is the time to plant the seed, is generally the dry month of Texas, even in localities where the rainfall is from 50 to 75 inches annually; the young plants need water every ten days in October. My crop last season was grown from transplanting time on with seven waterings and cost $1.50 per acre for each watering or $10.50 total, but there was not a single dry norther last season.

Convincing circumstances prove that it will be a long time before the growing of onions here can be overdone; there will be about 20 car loads grown here and at Cotulla this season, and 100 car loads could have been taken care of just as easily.



SUGGESTIONS ABOUT IRRIGATION.

By H. Woodmanse.

There have been many methods of irrigation tried in the arid and semi-arid territory of America, but what I am most familiar with is in western Kansas and Nebraska, although I have had some experience in New Mexico and other parts of the west. It is our impression that it is generally settled in the minds of all thinking people who have given this matter of irrigation much thought, that to raise water for irrigation it can be done most successfully by wind power and pumps constructed with a view to great strength and durability. Outfits have been made specially for this purpose, which have given very satisfactory results, and which will pump five times the quantity of water as the ordinary windmill and pump that has been made for general purposes. Practical irrigators have tried all methods, steam, gasoline, and almost every known power to get water to the surface, but the cheapest method for this purpose has been proven to be wind power. It is generally conceded now that windmill outfits are the only practical plan for the ordinary farmer, and one that will make success, being comparatively cheap. The outfit costs comparatively nothing to keep in repair, while a steam engine or any other power is a constant expense, much more than the ordinary farmer can afford. It may be said, there is a time coming when on nearly every farm in America there will be one or more pumping plants lifting water from an underground supply to be thence carried out over the lands in small canals and laterals that will insure a crop. The future of wind-

mill irrigation is great and practically limitless. I think there is a limit to the height water can be lifted for successful irrigation, and where water can be had from comparatively shallow wells, as in a great portion of western Kansas and Nebraska, from twenty to thirty feet deep, it bids fair to produce the best results.

We have heretofore made windmills for lifting water for animals and domestic purposes only, but this field for irrigation has been opened and bids fair to outdo all other uses that windmills and pumps have been put to. Bear in mind, however, that the ordinary farm windmill will not answer for irrigation purposes. This is where the only failures have been made with windmills. No doubt the people require some education on this question of irrigation, but it can be safely said that a windmill plant properly conducted on a farm, will double the value in producing power of the land anywhere from five to ten times in the arid and semi-arid country.

Arid and semi-arid America is one-half as large as the United States proper. It has a population of about 5,000,000. With irrigation at a reasonable first cost this section can support many millions more.

A family with ten acres of ground and a good well and windmill with plenty of water has a sure living.

Water has been pumped from 150-foot wells by windmills for irrigating, and some places deeper, but we think the best results can be got from the shallower wells spoken of above.

In the year of 1896 the state of Kansas appropriated $30,000 to be disbursed by a temporary irrigation commission in demonstrating the feasibility of irrigation in western Kansas by means of the windmill and pump systems. While it had been thoroughly understood that from the shallower wells there was no question about the advantage, what they were testing was deeper wells, from 100 to 200 feet deep. We put in quite a number of plants during the latter part of 1895 for the state of Kansas, but of course they have not done enough yet to demonstrate how much land can be irrigated from these deeper wells. The wells we have put plants on run from 75 to 185 feet deep.

It will cost about $10 per acre to prepare and get ready with machinery, windmills and pumps, to irrigate the land, and the most fertile land known in the country can be bought for from $4 to $8 per acre. You will see by adding $10 per acre to it you have a very cheap farm and a certainty of a crop, with irrigation. This is more than any of our farmers in the humid country can expect. It is either not enough water or too much.

The great trouble with the country being improved as fast as we would like to see it, is the condition of the people, as they have but little money to make any improvements with, having gone there and

practiced what they call dry farming, until they have exhausted all their means, and have become very much disheartened. We think there is a great field for capitalists who have loaned money on this western land, to add a little more to it and get back what they have invested there with from 100 to 200 per cent. interest. Under the past, depending on farming without irrigation, nothing short of a miracle will ever return this large amount of money loaned on their land. I have been told there has been at least $2,000,000,000 loaned on western lands in Nebraska alone. The proposition may be summed up about as follows: Irrigated land will produce a crop with almost if not altogether positive certainty, while even in our humid districts it is quite a speculation whether you will get a paying crop or not. The idea that irrigation is only feasible and practicable in the arid limits of America may be called one of the delusions and fallacies of the day. Irrigation can be made very profitable and insure a certainty of a crop within the humid area as well as the arid or semi-arid portions of America.

In the construction of reservoirs for holding the water for irrigation, but little money is required. It is work that the farmers can perform entirely with the use of their teams. The inside and bottom of the reservoirs can by padding and packings be constructed so as to hold water almost equal to the ordinary railroad tanks, and of course in very much larger quantities With the old canal system, which can be used only in a small area adjoining streams, the cost of water rights varies from $8 to $30 per acre, and the cost of the annual maintenance of the canals and direct connection with the required water right is from $3 to $5 per acre as we understand it.

Providence has provided substantially a large lake of water under the greater portion of this arid America, furnishing a supply practically without limit.

IRRIGATION IN IDAHO.

(Extracts from a recently issued Bulletin.)

A recent bulletin issued by the census office on agriculture in Idaho, shows very conclusively that irrigation has done much for the farmers of that state. Not only has it aided in increasing the area of farming land, but it has multiplied the value of such land, and brought about an enormous increase in the agricultural production of the state. The following quotations are made from the bulletin:

"The greater part of Idaho lies well within the arid region, but a narrow prolongation in the northern part of the state, adjacent to Canada, extends into a comparatively humid region. The nonirrigated counties of Idaho, including Latah, Nez Perce, Idaho, Shoshone and Kootenai, reported 52.8 per cent of the cereal acreage of the state in 1899, and 56.9 per cent of the total production. These counties contained 83.3 per cent of the acreage in barley, 53.3 per cent of that in wheat, 40.9 per cent of that in corn, 36.6 per cent of that in oats, and 12.4 per cent of that in rye. They produced 85.8 per cent of the barley crop, 59 per cent of the wheat, 40.7 per cent of the corn, 38.2 per cent of the oats and 20.4 per cent of the rye.

"The Snake River Valley is described as a broad, lava-covered plain, dusty and with a dense growth of sage brush and similar woody shrubs. The surface of the lava flow in most places is covered to a considerable depth by an alluvial deposit of silt and gravel brought down from the neighboring mountains. This, in turn, is covered by a soil of volcanic origin, which, when irrigated, possesses wonderful fertility. In the great central portion are vast lava fields, some portions of which are covered by a thin sandy soil, which, like most of the soil of the arid regions, is highly productive when watered. This central region is used chiefly as a winter range for sheep and cattle.

"Of the 53,945,600 acres of land surface in Idaho, 3,204,903 acres or 5.9 per cent were included in farms in 1900, and only 1,413,118 acres or 2.6 per cent were improved. Of the improved land, 1,385,596 acres are located outside of the Indian reservations. The irrigated land has an area of 602,568 acres.

"Within the ten years from 1890 to 1900 the investments in irrigation canals and ditches increased from $1,029,000 to $4,168,252, or 30.5 per cent. There were 36 canals involving a constructive expense of $947,975, which distributed no water in 1899. Three canals, which had involved an outlay of $480,000, were failures by reason of mismanagement. The area under the ditches not operated, which ultimately will

be reclaimed exceeds 130,000 acres. In 1890 the acres irrigated, outside of the reservations, numbered 217,005; in 1900 they numbered 602,568. In other words, by the opening of new ditches and canals between 1890 and 1900, by the enlargement of canals previously constructed, and as the result of better methods of water distribution, 385,935 acres were added to the productive area of the state. Most of this land was public domain in 1890, and comparatively valueless. At a low estimate its present value is $12,060,406, an average of $31.25 an acre. Thus, irrigation has in 10 years increased the improved area by 37.6 per cent, and has added approximately $12,000,000 to the farm wealth of the state.

"The total number of acres of irrigated crops is 508,183, while the total number of acres of land irrigated is 608,718. The difference of 100,535 acres represents approximately the acreage of pasture land irrigated, and the area of land summer fallowed. It is probable that a portion of the area upon which crops were reported as grown without irrigation was really irrigated at some time during the year.

"The number of acres of irrigated land for each mile of ditch is 121, while the number of acres under ditch for each mile is 271. The present number of ditches, if furnished with sufficient water and properly managed, would, therefore, more than double the cultivable area. The average cost of constructing the ditches was about $1,028 per mile, $3.79 per acre of land under ditch, and $8.46 per acre of land actually irrigated in the year 1899. An explanation of the high average per acre for all land irrigated is to be found in the fact that some of the ditches reported were not completed early enough in the census year to aid in maturing crops for that year; while from others, because of mismanagement, no adequate returns have been received for the large sums expended in their construction. The average cost of construction, per acre irrigated, of wisely planned and economically constructed ditches, does not vary much from the average cost of water right.

"The average value per acre of land under ditch not yet prepared for irrigation, though within reach of ditches, is $9.51, while that of irrigated land is $31.25. The difference represents the value added by irrigation. Of the 17,471 farms in thc state, including those in the Indian reservations, 9,188 are irrigated and 6,283 are unirrigated. The acres in the irrigated farms number 1,677,398 and the unirrigated 1,529,585. The value of all land in the irrigated farms, not including buildings, is $21,850,135, and in the irrigated farms $13,636,233. The average size of all farms is 183 acres, and that of irrigated farms 182 acres, while the average area of irrigated land in each irrigated farm is 66 acres. For farms making use of irrigation, the average value of the product for the census year not fed to live stock, was $7.29 per

acre. The average value per acre of products not fed to livestock on unirrigated farms was $3.74. The average value of land, exclusive of buildings is, for all farms, $11.15; for unirrigated farms, $9.11; and for irrigated farms, $12.94. The average value of irrigated land per acre is $31.25, while that for the best irrigated land suitable for the growing of fruit, ranges from $60 to $500 per acre.

"The total value of all crops produced on irrigated land in the census year was $5,440,962. The values of the several irrigated crops were: Hay and forage, $3,219,156; cereals, $1,275,858; vegetables, $544,314; orchard fruits, $291,007; small fruits, $38,190 and other crops, $72,437."

"TALKED ABOUT."

The neighbors talked about her nearly everywhere they met,
They talked about her till she died; they talk about her yet.
The high and low all spoke of her, as did the old and young,
And every gossip tossed her name upon her nimble tongue.

She always kept a-doing things, by night as well as day,
To set the tongues a-going in the swiftest sort of way;
Across the back-yard fences and from door to door.
At church and sociable her name was whispered o'er and o'er.

'Twas she who kissed the baby first and blest its happy birth;
'Twas she who helped to guide its feet through all the paths of earth;
'Twas she who watched beside the bed whereon the dying lay,
'Twas she who soothed the stricken friends when one was called away.

The neighbors talked about her nearly everywhere they met;
They talked about her till she died; they talk about her yet.
They talked about her wondrous hands, her heart so full of love,
And now the angels talk of her who dwells with them above.

—Nixon Waterman, in L. A. W. Bulletin.

RRIGATION PLANS.

BY W. W. JERMANE.

The following was Washington correspondence under date of June 21 to one of our exchances:

When the president wrote his name at the bottom of a bill of congress last Tuesday he performed an act whose importance will be far-reaching. The bill which he signed was the famous Hansbrough irrigaticn bill, and from this time forward the government is committed to the policy of developing and making ready for settlement the arid and semi-arid lands on the eastern slope of the Rocky Mountains, and on the Paciffc coast.

Several of the more prominent of the great newspapers, the New York Sun among them, have been indulging in heavy editorial assaults upon the bill, presumably in the höpe that the president would be influenced by them. The Hansbrough bill—so they call it, and that is the right name—is vicious in principle, they say, and will impoverish the national treasury. The latter proposition is the one in which they give great emphasis; but there is no danger that they will become true prophets.

There are now $4,000,000 of available cash in the treasury for irrigation purposes, and the sum is growing steadily. Probably the fund will never be exhausted, for the president's policy will be to extend the work so carefully and systematically as to keep it always within due bounds. On Wednesday of this week there was an hour's conference between him and Senator Hansbrough, at the close of which, the subject not being completed, an arrangement was made for another meeting, at which it is their plan to work out the details of the administration irrigation policy. The president thinks that the work will pay for itself as it goes along, and that it never will be necessary to appeal to the national treasury for aid. With Senator Hansbrough, he says that it will be possible to irrigate half a million acres per annum, on an average, for the next quarter of a century. The work will be kept within proper limits, for it is realized that if the policy now initiated is to continue there must be proper management and strict economy. The president has something at stake; for both have said, the former in his message to congress, in which irrigation was strongly recommended, and the latter in his speeches to the senate and senate committees, that the work should never be made a charge againt the public treasury. Without further argument it may be accepted at once that there will be no extravagance in putting

the new law into operation, and that it will be the purpose of the administration to show that the anti irrigationists of the eastern states have talked unadvisedly.

The most important project under the new law, so far discussed, looks to the irrigation and rapid settlement immediately thereafter of half a million acres of land in north central Montana, and in northwestern North Dakota, along the line of the Great Northern railway. This is known as the St. Mary's project, and if carried out, it will add immensely to the popluation and material wealth of the country through which the Great Northern runs.

The second largest project east of the Rockies has to do with an extensive tract of land in south central Montana, known as the Yellowstone park project. It will fertilize a large tract of land tributary to the Northern Pacific railway.

Western senators and members of congress who were interested in irrigation made their first definite organization for concerted action at the beginning of the fifty sixth congress, in December, 1890. At that time a meeting was held at the home of Representative Newlands, of this city, attended by about 18 men. An elaborate dinner was served, and over the cigars and wine the subject of irrigation was discussed fully, and Senator Hansbrough was unanimously selected to represent the new movement in the senate. This honor came to him because in the fifty-fifth congress he had made a strenuous effort to attach an irrigation rider to a general appropriation bill. He failed, being ruled out on a point of order, but the matter went far enough to attract the attention of both houses and to mark Hansbrough as an earuest and aggressive irrigation advocate.

Nothing was accomplished in the fifty-sixth congress. Before the assembling of the fifty-seventh (the present) congress, President McKinley was assassinated. Early in October Senator Hansbrough came ail the way to Washington from North Dakota to confer with the new president and uge upon him the advisability of recommending irrigation in his message. It was the first time the attention of President Roosevelt had been drawn to the subject in a concrete manner. He liked the suggestion and acted upon it. After congress had assembled Senator Hansbrough drew up the bill, which with certain minor amendments, is now the law, and introduced it. Then came a series of animated conferences, extending over a period of more than a month, between the western members of both houses who favored some irrigation government policy. They ultimately adopted the Hansbrough bill as the busis of their deliberations and, in the end, although differing widely as to methods, adopted it and it passed the senate. In the house the chief stumbling block in the way was the speaker, who, with the committee on rules, did not look kindly upon

the proposed legislation, and announced that it should not come up with his approval. The house, by overwhelming voice, decided that the bill should come up, speaker or no speaker. The leaders went down to defeat, and a day was fixed for the consideration and vote.

In the irrigation states the irrigarion forces were early divided, one wanting state supervision and control of the reservoirs and ditches, and the other standing for federal control. The latter side won. The former represented the immense cattle ranges of the West, the latter the small homesteaders. It was on this rock that the friends of irrigation almost permitted their ship to go to pieces. Senator Hansbrough stood at the side which favored federal control. His original bill contained this provision, and caused the extended conferences between the irrigation members referred to above.

Among those who favored state control were the members from Wyoming, a great cattle grazing state. After their defeat, the cattle members tried to prevent the passage of an irrigation bill. Seeing ultimately that the influence of the president in favor of the Hansbrough bill was to prevail, they fell into line, and during the past month of the legislative career of the bill placed no obstccles in its way. After the bill had been signed by the president, Representative Mondell of Wyoming went to the White House and asked the president for the pen with which the official signature had been attached. It was given. Mr. Mondell, however, was almost as little entitled to that pen as one of the avowed opponents of the bill. Bnt the gift of the pen was a small matter, and Mr. Mondell was permitted to bear it away in triumph.

It was the pressure from the White House which brought victory in the house. Messrs. Cannon and Payne, for instance, two of the stalwart leaders on the republican side, the one the chairman of the great committee on appropriations, the other of the great committee on ways and means, were steadfastly opposed to irrigation. The president took them in hand, and finally they yielded to him to the extent of being willing to refrain from speaking against the bill. They were silent during the whole of the debate, but on the roll call on final passage voted in the negative. Other influential republican members from the eastern states were controlled in a similar way. Not all of them could be thus controlled, however, as the record of the debate will show, but the presidential influence was great enough to reach enough of them to insure favorable action.

Within a week or two it is believed that the president will know pretty well what his plans for the present season will be. With $4,000,000 in cash available for the commencement of active work, it can be understood that considerable preliminary progress can be made this year. It is the president's desire to make a start at once,

and he is to consult with the secretary of the interior regarding ways and means of going ahead. Before that, however, as already has been stated, he will formulate a general policy in conjunction with Senator Hansbrough, who is probably the leading irrigation expert n the senate.

North Dakota will be largely benefited by the new law. Between the point in the far western part of the state where the Yellowstone empties into the Missouri, and the point east of it where the Fort Berthold military reservation begins, there are numerous points where small reservoirs can be profitably built, for the irrigation of small valleys on both sides of the Missouri river. In the southwestern section of the state, along the Little Missouri, another chain of small reservoirs can be placed to advantage, for the irrigation of land on which alfalfa and forage crops can be grown,

In western South Dakota a line of improvement similar to that suggested above for North Dakota, will be possible. The chief trouble in the Dakotas will be, not lack of land which needs irrigation, but lack of water. Save the Yellowstone and the Missouri, their rivers are small. Enough can be done, however, in both states to improve greatly the western plains and increase their population and wealth.

Under the terms of the new law, the money collected from the sales of public lands within a certain state are to be expended, so far as practicable, within that state. North Dakota, therefore, will derive a greater immediate benefit from the law than any other state of the union. There is now in her reclamation fund, available for purposes of irrigation, half a million dollars. No other state has so large a sum. Nevada, where irrigation is probably most needed, has only $9,000. The reccipts from the sale of public lands was greater in North Dakota last year than in any other state. It will be difficult for the secretary of the interior to find opportunities to expend within the state all the money now available there for irrigation works. Of course, those parts of the fund which are not used will be diverted into other states.

AGRICULTURE.

ORCHARD SPRAYING.

Throughout the southern portion of Nebraska the most pressing work at this time with the orchardists is spraying to guard against our insect enemies. While the dry weather which we are having is unfavorable for the wheat it is quite advantageous to the orchardist; it allows him to select suitable time for spraying and to do this needed work at just the very best time to accomplish the desired purpose. In preceding springs we have oftentimes done a good deal of laborious work in spraying, and then had much of that which we hoped to accomplish destroyed by heavy showers or long continued rains; the fact that after years of comparative failure our orchards are now promising bountiful crops should impel to renewed and intelligent efforts to make the most of the crop of fruit already set in our orchards.

Since 1881 the apple orchards have not set so much fruit as this spring. Nearly all of the apple blossoms were evidently properly pollinated and the trees at the present time have set a great deal more fruit than they can carry. The properly balanced farm seems to be likely to gain as much on their fruit orchards as they lose by the grain crop being below the average. Now that our apple orchards are so full of promise it is possible that your readers may be interested in some of the particular details connected with the active work of spraying.

In southern Nebraska the codling moth rarely commences to fly and deposit eggs before the middle of May, and from that time until the first of June or later it is active in getting in its work. We spray at this time, not because the coiling moth is at work, but because the most promising way to lessen the work of the first brood is to lodge poison in the calyx of the apple before the lobes of the calyx close so tightly as to render lodgement of the poison unlikely.

Professor Card in his work demonstrated that 80 per cent of the larvæ of the first brood entering the apple seek entrance through the calyx, doubtless because it offers the likeliest shelter for the young larvæ seeking refuge from the birds. Should spraying be delayed until after the calyx is very tightly closed we have then lost our best opportunity to intercept the larvæ of the first brood. If we can lessen the number of the first brood, we of course very greatly curtail the work of the second brood. The large number of trees we have to spray and the necessity of doing the work in a very few days makes it advantageous to use a horse-power pump. The power is applied by sprocket gearing from the hind wheel of an ordinary farm wagon. On this running gear is placed a timber frame strong enough to support a 200-gallon tank. We find this pump capable of applying eight tanks full or 1,600 gallons daily. Two hundred gallons are applied in fine misty spray in 45 minutes. Something depends on the water supply and the distance of the orchard from the water tank. If the pump could be supplied by another team hauling water it could apply from 2,400 to 3,000 gallons of the solution in a day. With our trees in age from 10 to 25 years we usually apply an average of two gallons to the tree, covering without the help of a water-hauling wagon about 800 trees of the larger sizes per day; this with a driver and one man to direct the spray from four seneca nozzles. We have been using a horse-power pump some twelve to fourteen years, using hand pump only on very rough ground and where it was difficult to run a horse-power pump. The objection urged against the use of the horse-power pump is that the pump passing the tree at the speed of a

walking team is not likely to apply a sufficient amount of spray to do effective work. With this fact in view we drive twice around each row of trees, spraying twice from each side. We have found it necessary in former years to spray the trees at three and sometimes four different times during the season. The first time commencing four to six days after the blossoms had fallen and the young apples were noticeably formed. During the early years of our work we used London Purple because it seemed to be more readily kept in suspension in the water than Paris Green. Not always being careful to use enough lime to neutralize the arsenious acid we sometimes burned the foliage of our trees. For three seasons we have been using green arsenoid, costing 15 cents per pound, manufactured by the Adner Color and Chemical Works of New York city.

To spray the tree while it is in bloom or before it was completely out of bloom would be likely to destroy the blossom and prevent pollination. Work cannot be commenced until the petals have fallen, until pollination has taken place and the apples are beginning to swell and form.

It is advantageous that the orchard could be planted in rows with varieties blooming at like periods; that is, it would be unfortunate to fill out a Ben Davis row with Rawles Jenet since the Rawles Jenet would be just in bloom when the Ben Davis would be ready to spray. In windy weather the work of spraying is very disdisagreeable, and care should be taken to absorb as little of the poison as possible. A long-continued season of spraying almost always effects the health of the workman. The hand pump can be used with greater safety and less exposure to the poison than in the use of power pump, our high winds blow the spray over workmen, horses and harness. Rubber coats are hot and clumsy. The workmen ambitious to crowd work along are usually wet most of the day.

The use of a considerable amount of lime causes the solution to stick to the foliage better, and neutralizes the arsenious acid and renders it less liable to burn the foliage. We see no objection to using as much lime in the composition as can be freely passed through the nozzle.

Since the first year of spraying we have not been troubled with the tent caterpillar. It is not possible for them to exist in an orchard that is sprayed, and spraying also holds in check the canker worm. While the canker worm is not as destructive in Nebraska as in Missouri there are yet enough of them in and about the older orchards of the state to require watchful care. They breed and feed on the honey locust, and wherever honey locust timber or honey locust hedges are adjacent to the orchard it will be will be well to watch closely from the first to the 15th of May for the canker worm. Among the natural remedies the birds are placed first. Since the canker worms pass the major portion of the year in the ground a perfect system of cultivation has its value. We have also kept them completely in check by our system of spraying. It is not possible for a canker worm to live on the foliage of a tree that has been carefully sprayed with the formula in use for the codling moth.

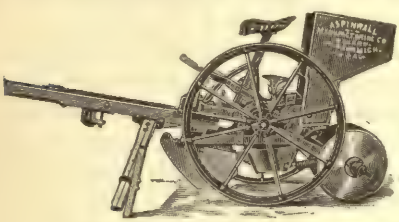
Spraying also holds in check the leaf rolling caterpillars, the crumpler, and the leaf-feeding caterpillar. The spraying which is done in May and June should be followed ten to fifteen days later by another spraying of the same character. About the 10th of June is the time to commence applying bands of paper or burlap to the trunks of the trees to intercept the larvæ seeking places to pupate. On the value of spraying with arsenical poisons in July and August, to destroy the second and third broods, orchardists are not fully agreed. Apparently it is well to be very thorough in that portion of the summer spraying which is done in the

month of May, hoping to destroy so large a percentage of the first brood and to render work of the second and third broods less destructive.

E. F. STEPHENS, Crete, Neb.

POTATO MACHINERY.

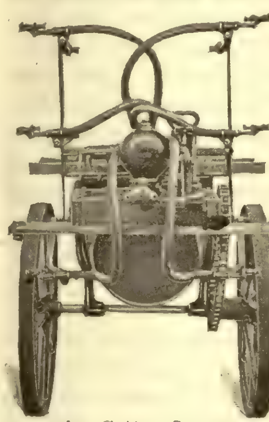
Aspinwall potato machinery embraces a line of farm implements which will appeal strongly to the practical irrigator as possessing all the requirements for success in the establishing and furthering of potato culture throughout the reclaimed portions of the country where the soil, combined with requisite moisture, is peculiarly adapted to the growth of the tuber. The superior quality of the western potato and the ready market it finds in many portions of the country is a matter of general knowledge. From the standpoint of economy, the desirability of the use of time, labor and money-saving tools, especially upon large acreages, is conceded. The extensive sale which has universally attended the introduction of potato machinery gives sufficient force to the statement that the western grower will not be slow in turning to account every useful means of up-to-date farming.



Plain Planter.

The Aspinwall Manufacturing Co,. of Jackson, Mich., who were the originators of the first successful machines for cutting, planting, cultivating, harvesting and assorting potatoes, have for years made a careful study of the requirements of the grower, not only in this country, but abroad, which has resulted in the production of the only complete outfit of these machines on the market to-day. The originality of their implements is a quality much remarked; no imitations, makeshifts, unnecessary attachments, useless combinations or parts are to be found. Characterized by simplicity and mechanical principles uniquely employed for practicable work, the distinctive feature of the line is apparent.

The cutter prepares the seed rapidly and in an entirely satisfactory manner for immediate planting, so there is no delay, The planter opens the furrow, plants, fertilizes, covers and marks all in one operation. With the four-row sprayer the vines are protected from bugs and blight. The digger is fully on a par with the planter and does first-class work. The sorter is a prime favorite with thousands of large growers, shippers, and commission men. In addition to the above the Aspinwall Company manufacture a line of cotton sprayers to protect cotton from the attacks of grasshoppers, coreless worms, spring web worms, leaf and army worms and the much dreaded Mexican boll weevil.



Dairy Cotton Sprayer.

A catalogue giving full description of the above machines may be had for the asking, and is well worth reading and preserving for reference.

RECENTLY STARTED.

The Fort Hays Military Reservation has recently been opened up as a branch of the Kansas State Agricultural College Experiment Station. J. G. Haney, superintendent of the Fort Hays branch, says: "There are nearly 4,000 acres of good tillable land that the first furrows were broken on only

two months ago. The location is such that results will be applicable in all of the so-called 'semi-arid West,' and will undoubtedly become one of the most important stations in this region. We will endeavor to solve some of the bothering questions as to kinds of crops, methods of cultivation, and feeding of stock; also to do something along the lines of irrigation, forestry and horticulture."

AGRICULTURAL SURVEY OF ILLINOIS SOILS.

The Agricultural Experiment Station of the University of Illinois in co-operation with the Bureau of Soils of the United States Department of Agriculture is beginning an agricultural survey of Illinois soils. A field party, consisting of two men from the Bureau of Soils and two men from the Illinois Experiment Station, is now at work in Tazewell county. In conducting the survey the ground is gone over carefully and the soil is examined to a depth of from three to six feet, samples being obtained by boring with augers. Soil maps will be made which will show the area and location of all of the different important types, or classes, of soil in the land surveyed. The Experiment Station will follow up the work of surveying by collecting and analyzing representative samples of soil from each of the different types which are found in large areas. As far as possible the Experiment Station will also locate experiment fields upon the most important types of soil and conduct investigations by actual trial upon the field to determine what kind of treatment each type of soil should receive to insure the maintenance or increase of its fertility and the improvement of its productive capacity.

The results of analysis and experimentation, together with the soil maps will finally be published in the form of Experiment Station bulletins. It is believed that about 1,000 square miles of Illinois land can be surveyed this season. About half of this will be in Tazewell county, in the north central part of the state, and the other half in Clinton and St. Clair counties in Southern Illinois. Those localities are selected by the Experiment Station because they contain several distinctly different types of soil which are believed to be representative of large areas in the state. A special circular to the press will be issued in a few days giving more complete information relating to the matter of soil investigations.

CUBA'S AGRICULTURAL RESOURCES.

The Island of Cuba is a gigantic farm of 28,000,000 acres of marvelously fertile soil. Thirteen million acres remain as virgin forest. Her present population is a little over 1,550,000. Were Cuba as densely populated as Massachusetts, her census would show 11,000,000 inhabitants. An equal density with that of England would give her upward of 22,000,000. Her ability to support a population per square mile equivalent to that of England, so large a percentage of which is dependent upon manufacturing, is somewhat doubtful, from the fact that Cuba presents little or no possibility of ever becoming a manufacturing center. In a measure, the comparison with Massachusetts is also faulty, for the same reason. Yet, in the latter case, the vastly greater fertility of Cuban soil would offset the manufacturing feature, and there is little doubt that Cuba, along the lines of her particular agricultural advantages, can provide a comfortable and reasonably profitable living for a population of 10,000,000 of moderately industrious citizens.

IRRIGATION.

SHOULD TEACH IRRIGATION.

By T. C. Nye, Laredo, Tex.

I visited the Agricultural and Mechanical College last summer, June 23, when the Farmers' Congress was in session and found about 400 of the most successful rain farmers of Texas in attendance and, as I am compelled to use irrigation in my farming, I was alone in that crowd. I felt that my stories about irrigation were regarded as fairy stories. Our Agriculture and Mechanical College, which had an income of $73,000 last year, is a splendid institution, and proposes to teach our boys agriculture and the mechanical arts. With over half of our state land lying in the dry zone and with the healthiest climate in the world, I could not help but think that our Agricultural and Mechanical College should be teaching irrigation also, and at the time of the meeting there was no place in Texas where irrigationn

T. C. NYE, LAREDO, TEX.

was needed any more than right there at the Agricultural and American College.

Our state school funds are loaned to the cattle men at three cents per acre per annum, which is not a decent rate of taxation, and all of these lands are in the dry belt and never will be good for anything without irrigation. Mr. F. F. Collins, who has a farm in the corporate limits of San Antonia, rents his land to Belgian gardeners at $22.50 per acre, Collins supplying the water and homes for the tenants to live in. Collins' land is worth $2.50 per acre.

Our state convicts could not be employed better than in building reservoirs and boring artesian wells, and thus reclaiming the deserts of Texas, which now produce nothing but coyotes and cactus. The land, as soon as water could be put on it, would be worth not less than $50 per acre, whereas as it is now it lacks a dollar of being worth a cent. The rain farmers of Texas make our laws for western Texas, where we consider ourselves very lucky if we get the dust laid once a year, just the same as for that part of Texas where there is not less than fifty inches of rainfall annually.

The irrigation farmer can grow upon one acre as much as he formerly grew, without water, upon ten, provided he uses some labor, intelligence, and lots of fertilizer, and is not too conceited to learn how. Some men cannot learn to adapt their farming operations to the climate where they are situated and stubbornly persist in following methods that were in vogue when they were boys in New York state; consequently if all failures were recorded it would make a long account.

There seems to be a general belief that when a man becomes an absolute failure in any other line of business he is then well equipped to go to farming, but that is positively not so. Irrigation farming needs constant study and the help of all the farm journals, and then there will be lots of

mistakes made; and the rain farmer needs a great deal more. An ounce of experience that is paid for is worth more than a carload that some one else paid for.

IRRIGATION AND THE ORIENTAL TRADE.

The most striking addition to Oriental trade literature is the recent address of William M. Bunker before the United States House Committee on Irrigation. Mr. Bunker discussed the interdependence of irrigation and the Oriental trade, and demonstrated the inevitable absorption by the Orientals of any possible food-stuff surplus of the far West. He said the Oriental demand for American food-stuffs is steadily increasing; the Orientals, in several localities, prefer flour to rice, and the increased tonnage in the trade between the Pacific Coast and the Orient will develop an immense market for our food-stuffs. With this unlimited market at our western doors, any increased food-stuff output resulting, through the reclamation of the arid lands, will be actively absorbed.

Having visited and crossed Asia as the representative of the Chamber of Commerce of San Francisco, in order to personally study the Oriental market, and that he might gauge the influence of the trans-Siberian railway on Pacific Coast interests, Mr. Bunker is thoroughly equipped for the discussion of his vital subject. His commercial story is more than interesting and instructive—it is tremendously suggestive. It mirrors, with obvious fidelity, a situation that hitherto has been only imperfectly seen. After grasping the facts and figures of Mr. Bunker's argument, and noting the actual increase in Pacific ocean tonnage, even the most casual observer must realize that the surplus food-stuffs of the far West will naturally and necessarily represent a large portion of the freight forwarded to the Orient. Mr. Bunker presents a vivid picture of the marvelous possibilities of American trade on the Pacific, and shows that irrigation will contribute largely thereto. Incidentally, Mr. Bunker shows how fuel oil is cheapening Pacific ocean transportation.

WHAT IS BEING DONE AT HINSDALE.

W. M. Wooldridge writes as follows regarding the new colony which the Great Northern railway is establishing at Hinsdale, Mont.: "A co-operative canal is being built which will reclaim 2,600 acres, at a cost of $21,000, nearly wholly in work, at the rate of $4 per day for man and team, and $2 per day for man alone. This is government land which has been entered under the homestead act. If a title were secured I could readily sell this land at $10 per acre with the water right in this canal, to the settlers now coming in. This would be $96,000 dedicated to the $21,000 of cost, leaving a net profit of $75,000 for these settlers for this year's work, which is not a bad crop of itself, assuming that the earning capacity of this land is $10 per acre per year, it means that $96,000 per year will be put in circulation in this vicinity; heretofore I believe that this was a very conservative statement."

CONSTRUCTING AN IRRIGATING PLANT.

Our reservoir at present is under construction. It will be about 110x50 feet and will hold a little over 30,000 gallons per foot of depth. We contemplate 10 feet of depth, though we are not likely to need such a depth, as we have quite an inflow all the time. Have 1,000 feet of two-inch pipe—about 550 feet running south and 450 running north of the pump, which is a rotary (Rumsey) No. 5, capacity 100 gallons per minute, with engine running 250 revolutions. Our engine is a Charter gasoline, five horse power. At every 100 feet or so of the pipe we put in a T, with plug in end of short pipe which extends

above ground 12 or 15 inches. We distribute the water in surface ditches or furrows from their T's. Cost of engine $350. I bought second-hand pipe of the Chicago House Wrecking Co,. cost 9 cents and 1 cent freight, $100. The fixtures, valves, etc., cost $30. The reservoir will cost over $100. It is worth to put in the plant $20. It will take 28,000 gallons of water to irrigate an acre "one inch depth of water." My reservoir will cover about 12 acres at each time, the repetition of which will depend upon the dryness of the soil and atmosphere and the condition of the growing plants. I will have blackberries, raspberries, strawberries, vegetables, etc. You may say to your readers that I use my engine to grind feed, meal and graham, and to make peanut butter in the winter when I can't use it to pump. Nut butter is a toothsome, wholesome, nutitions, healthful product, and is used just as other butter, without the danger of tubercular infection or possible uncleanliness or adulteration attending the manufacturing or sale of cows' butter. We will have it for sale and can furnish it in any quantity.

W. D. GILLIHAND, Atchison, Kan.

VALUE OF WINTER IRRIGATION.

The value of winter irrigation was apparent even in April. Fields of alfalfa unirrigated up to that time were almost as brown as in midwinter, while the fields that were winter irrigated were in fine growing condition.

The difference in the growth of alfalfa, with winter irrigation and without it, is strikingly illustrated with plots of alfalfa under experiment on the Agricultural Experiment Station Farm. Two plots were selected of as nearly the same type of soil as possible. One plot was winter irrigated while the other was not. The unirrigated plot was at that time apparently almost lifeless, while the plot receiving winter irrigation has made a fine growth of from six to eight inches.

The late frosts have injured the growing alfalfa slightly, but this damage is insignificant when the two plots are compared. One year ago we had severe late frosts and the alfalfa receiving winter irrigation wrs damaged considerably, yet the field of hay was docidedly in the favor of the plots which received winter irrigation.

There is, however, another point which should be carefully considered when weighing the value of winter irrigation. That is, the benefit derived from re-establishing capillarity with the ground water. Capillary action is the name given to the passage of moisture up through the interstices of the soil, which is nicely illustrated in the the passage of oil up through the interstices of the lampwick. Evaporation carries moisture off from the surface of the soil much as oil is burned off from the lampwick. The loss of moisture from the surface soil is replaced by the movement of moisture through capillarity from the soil below and this, in turn, is replenished from still lower layers of soil, until, finally, the draft upon the moisture may reach the ground water. Drouthy spells dry out the soil to quite a depth, sometimes several feet deep, and, therefore, the capillary action is broken and will not reach the surface again until it is re-established by making the soil wet from the surface down to moisture.

This wetting of the soil seems to be a sort of priming of nature's pumps which she attends to herself in rainy belts by frequent showers, but leaves to the care of man in all irrigation sections. The re-establishment of capillarity can best be done in winter when evaporation from the surface soil is at a minimum and at a time when water is abundant. If the soil is well charged with water for several feet in depth during winter, much of the water will be available for the crop during the growing months of spring and summer. The root of the plants will push down into the moisture and capillary attraction will

bring the moisture towards the surface, thus rendering it available to the plants.

In sections where water is not plentiful for irrigation purposes during all seasons of the year, the question of the storage and conservation, in the soll, of the flood waters of winter is of great importance, and the writer believes that more attention should be given to it, at least until dams, reservoirs, or other larger storage systems can be established for the conservation of the waste waters of winter and flood seasons.—*J. J. Vernon, in Press Bulletin No. 63, New Mexico College of Agriculture and Mechanic Arts.*

THE DEMPSTER ENGINE.

The following good points are claimed for the Dempster Gasoline Engine by its makers, the Dempster Mill Mfg. Co., Beatrice, Neb.:

"The Dempster can be used for power to do any kind of work and can be run by anyone of ordinary intelligence.

"Requires but little attention except starting, cleaning and oiling.

"No boiler, water heater, feed pump, coal, fire and ashes to look after, nor grate bars to burn out and replace.

No expense when not running.

"Ready for use any time, day or night."

OUR EXCHANGES.

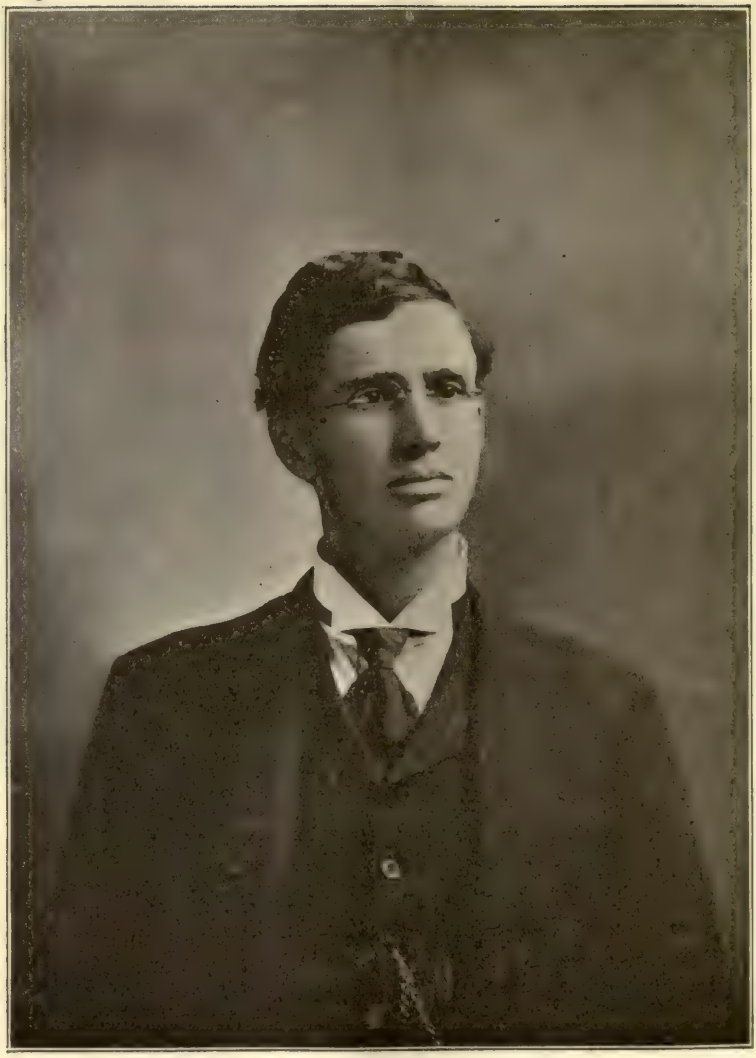
The theory of some scientific men that the world has almost reached the limit of its capacity to produce wheat is exploded in the article on "The New Agriculture" in the June *Scribner's*, which shows how the work of the Agricultural Experiment Stations has removed this catastrophe indefinitely from the impending possibilities.

The Forum Publishing Company announces that beginning with the July number, *The Forum* will be published quarterly, instead of monthly, as heretofore. The general character of the magazine will be the same, and its high standard will be maintained, but its purposes will be more specifically those of a review and outlook. It is believed that by publishing quarterly a review of the world's events in every field, as well as to some extent an outlook based on the conditions presented, the essential features can be fully covered.

We are in receipt of a neatly gotten up booklet entitled "Billings, Montana," which calls attention to the resources of the city and invites persons to locate there, assuring them that "Billings people will be found genial and hospitable, its climate salubrious, and its chances for gaining a competence, or even opulence, equal to any spot on earth."

The University of Illinois Agricultural Experiment station at Urbana has issued bulletin 69 on "Apple Rots in Illinois," by George P. Clinton, M. S. Considerable complaint has been made in this state of the loss of apples through rotting and during the past season the station made a special study of the bitter rot fungus and other apple rots of Illinois, the results of which are given in this valuable bulletin.

No better description of an Arizona "roping," or lassoing contest, has been written than Ray Stannard Baker's story, "The Roping at Pasco's," in the June *McClure's.* The conditions of the contest are simple; the cowboy wins who ropes, throws, and ties his steer in the quickest time. In this case young Turk McGlory of Texas carries off the prize, incidently breaking all records.



R. H. YALE, Beatrice, Nebraska.

THE IRRIGATION AGE.

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THE IRRIGATION AGE.

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A monthly illustrated magazine recognized throughout the world as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world, and has no rival in half a continent. It advocates the mineral development and the industrial growth of the West.

D. H. ANDERSON, - - Editor.

Interesting Matter. In this issue begins the first of a series of articles on Irrigation and Soil Culture, by H. W. Campbell, whose portrait we had the pleasure of presenting to our readers in our last number of the AGE. Rodney H. Yale, whose portrait forms our frontispiece this time, begins in this number the first of a series on Practical Pump Irrigation.

Work to Begin at Once. The government will at once begin work in the investigation of sites for irrigation reservoirs to be constructed under the provisions of the irrigation bill recently passed. There is about $5,000,000 available at once for the reclamation fund, the distribution of which is entirely in the hands of the secretary of the interior, who has discretionary power in the selection of localities where government irrigation works shall be established.

F. H. Newell, chief of the hydrographic department at Washington, will look over the much-talked-of site of the gigantic reservoir in the South Platte valley in western Nebraska and northern Colorado. This mammoth pool, when constructed, will store 12,000,000,000 cubic feet of water, a quantity sufficient to irrigate 250,000 acres of government land.

Thirteen states and three territories are entitled to share in the benefits conferred by the law—Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Arizona, South Dakota, Utah, Washington and Wyoming. This region contains about 600,000,000 acres of the public domain, at least 60,000,000 acres of which, it is believed, can be converted into farms if the water supply be scienti-

fically distributed and economically used, thus affording homes for 25,000,000 people.

The United States is the last of the great nations to officially take charge of this work, Italy, Spain and Russia spend great sums every year for irrigation; England has spent $300,000,000 on irrigation in India and a German company is preparing to restore the farms in the valley of the Tigris and Euphrates.

Study of Irrigation. The annual report of the director of the office of experiment stations of the National Agricultural Department will, according to the *New Orleans States*, show a gratifying progress in irrigation work in the Louisiana-Texas rice section, to which particular attention has been given during the past year. The report says that the lands in the Southwest furnish a striking illustration of the profits to be derived from the adoption of irrigation in that section. Even with the expense of pumping, rice-growing in those states has proven remarkably profitable. Lands which were formerly worth $1 to $3 per acre, and used only for grazing, now sell for from $30 to $40 per acre, and yield an annual return equal to the value of the land.

While the irrigation investigations have their greatest field of usefulness in the region where farming without irrigation is impossible, the report makes it certain that irrigation is destined to be widely adopted in the humid and sub-humid portion of the country.

During the past year important studies have been made in the sub-humid region by Prof. O. V. P. Stout of the agricultural experiment station of the University of Nebraska. This station is in a section where lands have been cultivated for many years, and where agriculture is a demonstrated success without the aid of irrigation. Results thus far secured show that the use of water on general farm crops will give sufficiently increased yields to repay the cost of providing the water supply and its distribution.

A series of experiments in the humid sections of the United States show that, as an assurance against drouth and an aid to intensive agriculture, irrigation is yearly becoming of greater interest and studies of the benefits of irrigation in Wisconsin have been carried on under the immediate direction of Professor King of the College of Agriculture of the University of Wisconsin at Madison and at Stevens Point. In both cases the water supply had to be provided by pumping, and records have been kept to show the amount of water used, the time of its application, the cost of pumping, and the increase in yield of the various crops to which it was applied. Owing to the exceptional drouth which prevailed, the results were highly favorable to ifrigation. The difference in yield between the irrigated and unirrigated potatoes was 160 bushels per acre. If the results of one season's trial would justify drawing a definite conclusion, it would be that irrigation in Wisconsin is a marked success.

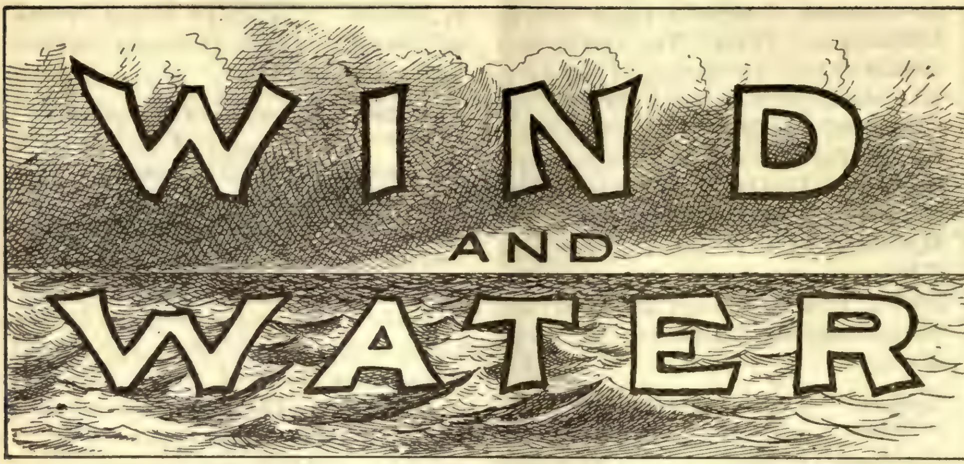
A similar investigation is being carried on at the Missouri experiment station under the direction of Prof. H. J. Waters. Apples, strawberries and nursery stock were the crops irrigated. It will require next year's record of the yield to determine the full measure of the benefits of this year's irrigation. Referring to the results of this year's watering of nursery stock, Professor Waters believes that nurserymen will find irrigation exceedingly profitable; and that it will result in securing larger growth in young trees, trees with better formed heads, and possibly a saving of one year in the time when nursery stock can be placed on the market.

A New Organization. The first annual meeting of the immigration agents of the Southern Pacific and Harriman systems was recently held in Galveston, Texas.

There were present over 220 real estate men who have been helping to develope the thousands of acres of fertile lands of Louisiana and Texas. The agents have decided to organize themselves into a regular organization to be known as the "Land and Immigration Agents' Association of the Southern Pacific Company." Ceorge M. McKinney, of Chicago, was chosen as president and John Howard, of Houston Texas, as first vice president. Fifteen other vice presidents were chosen. Fred C. Pickert, Chicago, is secretary and George Graybill, Shelbyville, Ill., treasurer.

Agriculture in Illinois. A recent census report on agriculture in Illinois shows that the farms of Illinois June 1, 1900, numbered 264,151 and were valued at $1,765,581,550, 86 per cent. of which represents the value of the land and implements other than buildings. The total value of farm property, including live stock and machinery, was $2,004,316,897. The value of farm product for 1899 exceeds that for 1889 by 87 per cent. Cook county, most of which is incorporated within the limits of the city of Chicago, is the second county in Illinois in the value of its farm products. It contains more farms than any other county in the State (2,827) and produces agricultural products annually of the value of nearly $7,000,000. Champaign county is the only one that exceeds it in the value of agricultural products.

Mississippi Forest Reserve. The Morris bill for the preservation of the timber at the headwaters of the Mississippi has passed the house, and has been favorably reported in the senate by the conference committee. The measure is the result of years of disinterested agitation by Col. John S. Cooper and others, who foresaw the necessity of preserving the natural reservoir at the head of the father of waters. In the Chippewa reservations at the source of the Mississippi, which comprise some 850,000 acres, there are ninety-seven lakes and seven rivers. By the terms of the Morris bill 95 per cent of the pine timber on 250,000 acres of the land is to be sold to pay the obligations of the Chippewas to the government, and the land is then to be set aside as a forest reserve under the care of the agricultural department. Col. Cooper and his associates tried hard to get congress to set aside the whole tract as a forest reserve, but 150,000 acres are allotted by the bill to the Indians, and the remaining 500,000 are to be opened for settlement.



PRACTICAL PUMP IRRIGATION—METHODS AND EXPENSE.

RODNEY H. YALE, Beatrice, Neb.

The practice of raising water with pumps, for irrigation purposes is perhaps as ancient as irrigation itself. It is a practical, positive and economical method where the conditions are favorable, and has brought subsistence, and prosperity as well, to countless thousands all along down the ages; and is today the main support and principal source of wealth in many of the most progressive and prosperous communities of the old and new world. And yet we hear some say that pump irrigation "is a failure." When we hear this said we should be charitable and remember that they do not *know*.

As we said in the beginning, pump irrigation is an economical, practical and positive method of irrigating if the conditions are favorable; if the conditions are not favorable we do not claim, nor should it be supposed, that success will be attained. If the conditions are not favorable for ditch irrigation you *would* not attempt it and if conditions are not favorable for pump irrigation you *should* not attempt it.

We have heard people talk about irrigating with pumps and raising the water 100 feet or more. If they ever tried to do this they failed of course to get satisfactory results, if field irrigation was attempted; and no doubt on the strength of such a failure would say "pump irrigation is not practical."

Pump irrigation should need no defense, as the practical utility

of the pump for this purpose is very clear; yet strange as it may seem, all sorts of queer ideas are entertained in relation to this subject, even among enlightened people. You never hear of any one trying to run water "up hill" in a ditch, but we have actually heard intelligent people talk of doing things with pumps about as impossible; for instance, some have entertained the idea that power is of little consequence in connection with the operation of pumps, and that to raise water in large quantities a hundred feet or so requires but little if any expenditure of energy. Such an idea is of course much like trying to raise yourself over a five board fence by pulling on your boot straps.

Every gallon of water weighs 8½ pounds, and it takes just as much power to move that 8½ pounds of water verytically upwards as it does to move any other 8½ pounds of dead weight the same distance and same way, and if you raise it ten feet it will of course take ten times as much power as to raise it one foot, at the same rate of speed; and if you raise it one hundred feet it will take ten times as much power as to raise it ten feet, and again, the power required increases with rate of increase of speed. Water is a dead weight, it is heavy, and if you are going to use it for irrigating you will require plenty of it, and if you have to lift it some distance you must provide ample power.

Some who read this article may say that it is unnecessary to state these self evident facts; perhaps it would not be necessary if the readers were all people of practical experience with pumps, but the article is not intended for those who know how 'tis done or how to do it, but for those who are not experienced and who require some advice and instruction to save them from the heavy expense of experimenting with impracticable methods,

To begin with it is important that your land should be located where you have plenty of water not over 40 feet below the level of your fields, if you intend to irrigate with pumps and raise field crops, and it is vastly better if water in abundance can be fonnd not more than ten feet below the level of your fields, as the difference in expense of raising the water ten feet as compared to raising it forty feet, is very heavy indeed. If you already have the land and it is more than forty feet to water and you have decided to irrigate with pumps, you had better sell out and buy again, where the conditions are more favorable. You can, however, irrigate with pumps successfully and raise the water fifty or even one hundred feet, if you give your attention to the raising of fruit and vegetables or some other highly profitable crop.

Unless you have a natural lake, river or creek to pump from the first work in the construction of a pumping plant will be the making

of the wells. An open curbed well is the best if the water-bearing sand is coarse enough and the strata is thick enough to furnish sufficient water. It is best because a pump will draw from an open body of water with a less expenditure of power. Sand points should only be used where a good open well is impossible; they are reliable and practicable, but an open well is better.

A good open well can usually be made by first digging a hole of required diameter (4 to 8 feet) down to the water-bearing sand and then curbing with 2x4 or 2x6 lumber, strongly girted inside with 2x6 or 2x8. A strong iron hoop or band should be placed at the bottom of the curbing and perhaps another at the top and still another in the middle would be advisable, if the curbing is long; sometimes it is advisable to leave the staves of the curbing loose so each one can be driven independently of the others. The sand can be removed from under the curbing with a shovel made especially for this purpose and having two long handles; then if the curbing is driven or weight applied it can usually be sunk the required depth; it may sometimes be necessary to pump the water out while the curbing is being sunk. Numerous small holes should be made in the curbing below the water line to let the water in freely, and it is generally best to cover them with perforated sheet brass or brass wire cloth, and some times it would be best to use both.

It is impracticable to formulate a set of rules for making wells for irrigation purposes, to fit every case; but if the general outlines named are followed in making wells of moderate depths, success will generally be attained.

If the local conditions prevent the making of an open well sand points may be resorted to, and usually with success. In sinking sand points, like open well making, no set of rules can be applied to every case, but the almost universal practice is to sink a pit of required diameter (4 to 8 feet) down to the water-bearing sand and then drive or sand pump the points to the required depth. Some times it will be better to use a number of small points for one pump cylinder, as it is not so difficult to drive them as it is to sink a point of large diameter; but usually a large open end point can be sand-pumped down to a good supply of water successfully, after which the lower end can be closed with a wooden plug or a bag of cement. Whether the points are large or small, they can always be connected to the cylinder with standard pipe fittings, and the cylinder, by the way, should always be placed as near the water line as possible.

The length of the points and kind must of necessity be governed by the local conditions. Where the water is not abundant, longer points will be required than where there is an abundance of water in coarse sand. Where there is a good flow of water, and it is found in

coarse sand or gravel, a point of moderate length and of ordinary 60 gauze will be sufficient. It is difficult to offer much information along this line, which will be of practical service in the selection of well points for any unknown conditions, and it is usually best to secure the advice of some practical well-maker, who is familiar with the exact local conditions when the question of the selection of points arises.

After the arranging for the water supply, the next in importance is the selection of the pumps and the power. There are many different ideas on this subject, particularly in relation to pumps; but it is almost universally conceded by men experienced in pump irrigation, that the common, single-actiug plunger pump, provides the most economical and practical way of raising water for irrigation purposes. Many other devices, such as elevators, rotary and centrifugal pumps are in use, but for economy in power, simplicity and durability, the ordinary plunger pump, of the type specially designed for irrigating, is much preferable. A good, strong, plunger pump of required capacity should be selected, and as many of them as the needs of the plant require; the cylinder should have large free valve ports for both plunger and check valve; the pipe between top of cylinder and outlet of pump should he one-fourth to one half inch larger in diameter than the cylinder, to permit the withdrawal of plunger and check valve without disturbing the remainder of outfit.

The pump top may be of any preferred style, the only special requirement being to have it substantial, and provided with an outlet large enough to carry the water freely as fast as pumped. It is best, however, to have this top provided with a removable cap, held in place with set screws so it can be easily removed when it is desired to take out the plunger and check valves. It is preferable to have the pipe between pump top and cylinder made of standard wrought iron casing, as it does not rust easily and cannot be jammed to damage it, and is by all means the most suitable material to use. It is a good plan also to use a base flange provided with several set screws to hold the pipe securely to the platform. The plunger rod may be made of pipe or wood, as preferred; but it should be strong, strong enough in fact so it will not break. If the pump is to be used in an open well, a short piece of pipe, capped at its lower end and drilled full of holes, may be screwed into the bottom of the cylinder; the weight of the pump being mainly supported on this pipe, the capped end resting firmly on the gravel in the bottom of well. If sand points are used the cylinder should be securely connected to same with standard pipe fittings.

For power, the most practical and economical way is to use one or more windmills in conjunction with a gasoline engine, utilizing the

inexpensive power of the wind whenever it blows, night or day, and the engine in emergencies whenever the windmills are found inadequate to supply the amount of water required. The windmills gather the power of the wind and apply it to the pumps without any running expense, except for oil and ordinary repairs. The gasoline engine uses no fuel, except when it is actually in operation. It is always ready for work, and can be started in full operation almost instantly; and when running, the expense for fuel per horse power is very moderate indeed.

The combination of these two very practical, economical and durable motors for raising water for irrigating purposes is certainly the most desirable arrangement known. Two to four pumps can be coupled to the engine and arranged so that one or all can be operated at once, as may be preferred. With the windmills, it is best to use but one single acting pump with each, of as large capacity as the mill will handled on its longest fixed stroke in a moderate wind.

A reservoir will be needed of course, to store up the water until it is required; and can be cheaply made in almost any locality entirely out of dirt, and will hold water first rate if well puddled.

Only a general outline of practical economical methods of installing an irrigation plant has been attempted in this article; specifications in detail, cannot well be furnished in a general way, and it is a waste of time to enter into the details as to the number of pumps required, the sizes of same, or power necessary for any certain work, unless the local conditions as to water supply, elevation, etc., are known. However, an approximate statement of the results to be obtained from pumps and from a practical pumping plant can be furnished with the assurance that they will be found mainly accurate.

It will cost $115 per acre per annum to irrigate with such a pumping plant as has been outlined herein and raise the water 15 feet vertically. This estimate covers the cost of fuel, repairs, interest on investment in pumps, power, reservoir, etc., at 7 per cent, and depreciation in plant 10 per cent per annum;also contemplates the probable loss of power in friction and loss of water by seepage and evaporation from reservoir, and contemplates the supplying of sufficient water from the reservoir to furnish 10 acre inches, *per acre*, which is considered ample, for the season, in most irrigation countries.

The cost of ditch irrigation varies greatly in different localities, but it would be safe to say that $15 per acre for a perpetual water right in a good ditch is a very moderate average. Seven per cent interest on this investment would be $1.05; add to this a very moderate annual assessment for maintainance of 25 cents per acre and you have a total annual expenditure of $1.30 per acre.

A water right in a good irrigation ditch is a splendid investment, but a good pumping plant, located where there is an abundance of water near the surface, in coarse sand or gravel, will prove a more satisfactory investment, and if rightly managed a more profitable one.

If you have a water right in a ditch, you are subject to the ditch rules and regulations, you cannot always have water just when you want it, or as much as you want, and you may have to wait indefinitely while damage resultiug somewhere along the canal, by floods or other causes, is being repaired, and then have to help pay for the repairs as well. Again, drouth or some other dire catastrophe may seriously reduce the water supply for the canal and curtail your allowance proportionately.

If you have a good, well-located pumping plant of your own, you you are "the captain"; it is all under your personal control; you don't have to ask for water, and perhaps wait an indefinite time for it; you can start your pumps and a supply is certain; floods or drouth don't effect you; the water flows when you want it and as long as you want it; you are independent of any outside control, you are *the* "boss."

To return to the subject of expenses, will say that in raising water for irrigation purposes it should never be lifted a foot or an inch higher than is necessary. Make your calculations carefully, as every inch you raise it more than is required is an extravagance and a useless expenditure.

COST OF IRRIGATING WITH PUMPS, WINDMILL AND GASOLINE ENGINE POWER.

Annual	expense	per	acre,	15	feet	elevation	$1.15
"	"	"	"	20	"	"	1.38
"	"	"	"	25	"	"	1.62
"	"	"	"	30	"	"	1.85
"	"	"	"	40	"	"	2.35

The above estimate contemplates, in each case, the supplying of 10-acre inches of water per acre during the irrigation season of 180 days.

An acre of water one inch in depth contains 27,154 gallons; 10 inches, 271,540 gallons. Obviously, an immense amount of water must be pumped if a large number of acres are to be watered, but a properly constructed, well-located pumping plant, built on the lines suggested, will be found equal to the requirements.

IRRIGATION AND SOIL CULTURE.

By H. W. Campbell, Holdridge, Neb.

At the present time the word irrigation is found in connection with some article in nearly all our leading publications. It has been discussed by all our great men in congress, and by the advocates of the bill just passed providing for government aid in the great arid west. It has been presented clothed in its most attractive garb, with the hope of reaching the hearts of the people. It did reach them, as the vote showed, and to its principle advocates much credit is due.

Now that the work is done, the bill has passed and the plans are being laid for spending the the money, discussions pro and con are certainly in order.

We are not going on record in this article as opposed to irrigation and its rapid devolopment in any manner whatever, but wish to discuss another side of the question that we believe, when well understood, will have as broad an effect upon the general development and prosperity of our great country as the bill just passed. For it not only applies to the irrigated sections in a very broad sense, making it possible to very largely increase the acreage of crops with the present available water supply, but it also applies to that great belt of country containing millions of acres of the finest and most fertile lands we have and that cannot be easily irrigated.

Nothing more tempting to the eye can be found than these broad, level prairies, when covered with a prolific and healthy growth of maturing grains, vegetables or fruits. All that is necessary to convince anyone that the passing of the irrigation bill is the commencement of a most wonderful change, is a comparison of the more arid portions of these prairies where, under natural conditions only sage brush and cactus seem to thrive, with the marvelous results obtained where water is applied to these lands, together with judicious soil culture.

In many sections lands that to-day are almost worthless may soon become valuable; the broad, black prairies may soon be dotter over with ideal farm homes, new towns may spring up and old towns again be made to flourish and prosper; in fact a new era seems at hand for the arid and semi-arid west.

But is all this to be the direct result of the passage of the irrigation bill? Oh, no; a very large part of it is to come from simple education in soil culture and the conservation of available waters, whether the water comes from showers or irrigation ditches.

Experience has already very clearly demonstrated that the aver-

age irrigator may produce even better crops with half the usual amount of water if he understands fully and clearly all the scientific principles of plant life and fully comprehends the real principles of moisture movements in the soil; how under certain climatic and soil conditions the moisture is lost by evaporation from the soil; how under other soil conditions evaporation may be reduced to the minimum and practically all the moisture that percolated below the surface may be stored and conserved in the soil and made available to the growing plant.

It is a conservative estimate to say that three-fourths of all the rainfall throughout the semi-arid sections is lost by evaporation, while it is believed by those most familiar with these facts, that at least three-fourths of the rainfall may be retained and conserved in the soil by proper cultivation and far the greater part of this made available to the growing plants. What is true with reference to the rain water is very largely true of irrigating water.

Whether the necessary water is supplied by irrigation or by rainfall the growth and final crop yield is very largely governed by the physical condition of the soil, which is good or bad, just in proportion to the manner id which it is treated, how and when the work of fitting the soil is applied, and what the applied condition of the soil is when the work is done.

There are many things to consider in the growth and development of a crop besides the mere question of supplying the seeds or plants with soil and water. When we take into account the fact that fully 95 per cent of all plant growth comes from the atmosphere, and that a large per cent of this water reaches the plant through the soil, we are confronted with a fact not fully appreciated by most tillers of the soil.

Much has been said in the past with reference to sub-irrigation, but the question has never been fully discussed. There are many ways in which the principles involved may be applied. It is not necessary that tiling or perforated pipe be placed beneath the surface soil, and water kept running in and through it in order to secure the direct results from the principles involved. The water may be stored in the soil below, either from the rain or from the ditch, and by cultivation or stirring the surface soil, producing what is known as the soil mulch, the moisture held there may be made available to the growing plants, provided the proper preparation and fitting is given that portion of the soil where the seed is placed and which the roots permeate for plant food and moisture. One of the strongest evidences and best illustrations we have of this fact is the growth and development of wheat or other plants covered by a heavy snowdrift, as compared with the part of the same field that was left bare of

snow. We have many times noticed wheat, where the main body of the drift lay, so thick and heavy as to indicate a forty to fifty-bushel crop, while the balance of the field would not indicate more than five to ten bushels. Was this radical difference due directly to the fact that the snowdrift covered the ground? No, it was due solely to the water that percolated from the melting snow deep down into the soil and returned by capillary attraction to feed the plants, keeping them healthy and growing vigorously long after moisture in the balance of the field was practically all exhausted.

We will go into details more fully on these important points in our next.

THE ORCHARD LANDS OF LONG AGO.

Oh, drowsy winds, awake and blow,
The snowy blossoms back to me,
And all the buds that used to be
Blow back along the grassy ways
Of truant feet, and lift the haze
Of happy summer from the trees
That trail their tresses in the seas
Of grain that float and overflow
The orchard lands of long ago!

Blow back the meody that slips
In lazy laughter from the lips
That marvel much if any kiss
Is sweeter than the apple is.
Blow back the twitter of the birds—
The lisp, the titter and the words
Of merriment that found the shine
Of summertime a glorious wine
That drenched the leaves that loved it so,
In orchard lands of long ago.

Oh, memory, alight and sing
Where rosy-bellied pippins cling,
And golden russets glint and gleam,
As in the old Arabian dream,
The fruits of that enchanted tree
The glad Aladdin robbed for me!
And, drowsy winds, awake and fan
My blood as when it overran
A heart ripe as the apples grow
In orchard lands of long ago!

—James Whitcomb Riiey.

IRRIGATION IN FIELD AND GARDEN.

By Professor E. J. Wickson.

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THE DEPRESSED BED.

The depressed bed, largely used in the growing of vegetables and small fruits, is really a form of rectangular checking. In this case, however, the levees are widened so that they are not merely boundaries to confine the spread of the water to the inclosed areas, but they are also made to carry water to these areas by small raised ditches which are made upon their tops. Fig. 15 shows an arrangement of this kind. It is best for light, sandy loam, which has slight retentiveness and therefore loses moisture rapidly both by drainage and surface evaporation and must be frequently irrigated.

Shallow rooting plants like strawberries, which would perish by the methods of irrigation employed for them on more retentive soil, and which will be described presently, make very satisfactory growth and have a long fruiting season if grown in a depressed bed, especially if they are mulched well with rotten straw or coarse manure

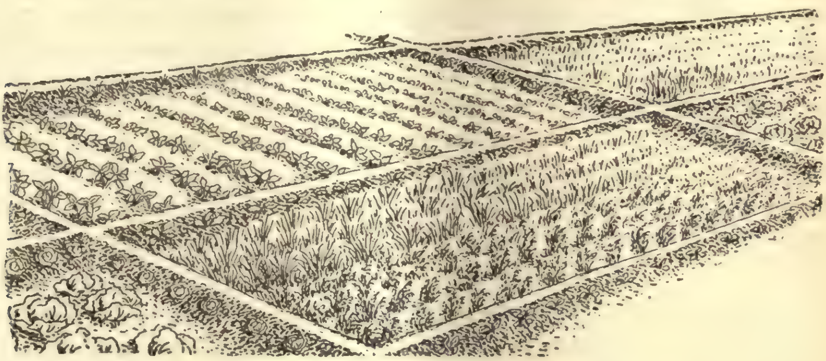


Fig. 15.—Depressed bed for vegetables and strawberries.

and the water allowed to distribute itself under this cover by admission from the raised ditch at several points at the same time. The ditch at the surface level is much less satisfactory in such work; consequently it is run along the top of the levee. This arrangement is particularly adapted to very light soils, as stated, and especially in the hotter parts of the arid region, where water has to be applied once or twice a week to shallow rooting plants and where the shading of the ground by a mulch lowers its temperature and protects the roots

from heat, which would be apt to destroy them in spite of the frequent use of water alone. This recourse takes the place of mulching and sprinkling and is vastly better for a hot, arid locality. The sprinkled water flies off from the mulch with great rapidity and much water is used with little benefit to the plant, while the filling of the depressed bed from the ditch and spreading the water through and under the mulch is very economical of water and of most direct advantage to the plant.

For the hot, dry season of the year, in places where there is no danger of supersaturating the soil, the depressed bed is available for all kinds of vegetables and small fruits and flowers, and the use of this system is really the secret of success in growing them in some regions.

It is quite widely employed also by market gardeners and others, even where heat is not excessive, bnt where a light, sandy soil predominates. A prominent example of this is in the sand hills south of San Francisco, where the vegetable growers, who are largely natives of the Mediterranean countries, have transformed large areas of hillsides into terraces and on these have arranged depressed beds, chiefly of quite small areas, and are growing large quantities of garden truck. The water is raised by windmills and pumps from wells in the low places and delivered into small flumes which run from the windmill towers to the opposite hillsides, supported by very light, high trestles. The water, after supplying the highest terrace, is conveyed most ingeniously by troughs or small ditches from terrace to terrace until all the beds have been filled. The terraces are so narrow and the beds on them so small and irregular in shape that depressing them and filling them from time to time seems about the only available way to make use of such little corners of leachy soil. The system calls for an immense amount of hard handwork, but the Mediterranean immigrant seems born to it.

DITCH-BANK IRRIGATION.

A simple form of depressed-bed irrigation, and one which is readily available for home garden work in the arid region, may be called "ditch-bank irrigation." It aims to use the water percolating from a raised ditch, which will moisten the slope of the bank and the soil for a certain distance outward from its base. Its prototype is perhaps the old permanent ditch of the Spanish settlers, which was opened out from a stream on a grade favoring a slow flow, and whatever land on each side was thus moistened was used for a few beans, onions, and peppers, which were about the only vegetables those settlers required. In the depressed-bed system the banks of the water-carrying levees are usually set full of quickly maturing vegetables.

Ditch-bank irrigation consists in a sort of a combination of the

old Spanish practice with some part of the more systematic depressed-bed practice of the Italian market gardeners. The method is to plow in deeply a good covering of manure and harrow thoroughly until the land is well settled. Then find a direction in which the land is nearly level and back two or more furrows to form a ridge. Rake over the surface, shaping up the rldge evenly, and on its crest mark out a narrow ditch with the hoe. Connect the head of this ditch with the water supply aud run in a small stream, aiding its course with a little cutting and filling until it runs evenly the whole length of the ridge. This will settle the ground, and some smoothing with the rake will be needed. When the ground is in good shape, sow the seed or set the plants along the top and sides of the ridge and along the base also. If the soil is not too leachy, the water will percolate slowly and evenly and moisten the soil without cropping out on the surface. The ridges can be multiplied and distribution of water to their several heads be arranged with troughs or otherwise, and the overflow at the ends can be led away to trees or clover patches. Water can be run from time to time to these channels as required, and the banks and bases can be used for a succession of vegetables.

The method requires work and care to arrange the grade, etc., in the first instance, but for the rest of the season the irrigation is automatic, though, of course, much hand hoeing will have to be done among the plants, for the constant presence of moisture and manure makes large weeds as well as vegetables. It is surprising, however how large a home supply of vegetables in variety can be grown on 200 or 300 feet of ditch bank.

RICE CULTURE IN THE SOUTH.

A correspondent of the New York *Tibune* writes thus interestingly of the progress of rice culture in the South:

Rice culture in the southwest, particularly in Texas and Louisiana, is increasing at a rapid rate, and the great profits resulting therefrom are attracting a large amount of capital to this comparatively new American industry. Rice is an easy cereal to grow, and on lands costing from $10 to $50 an acre one man, with the assistance of four mules, can cultivate 100 acres, making in many cases, it is estimated, about $25 net to the acre. According to the opinions of students of this country's agricultural products, rice is the most certain crop of all the cereals. And as an agent in producing energy in the human body rice is exceeded only by oatmeal, butter and cheese. Rice can even withstand western tornadoes and, and it is recorded that in the Galveston tornado of a few years ago the farmers on the lower Colo-

rado river lost all their cotton, while their rice crops not only withstood the storm, but yielded seventeen bushels to the acre.

It may be put down as a fact that an intelligent farmer, with suitable soil and plenty of water, will make more money out of rice than in almost any other branch of agriculture. This is due to the fact that the demand for this cereal is growing rapidly and to the fact that the crop is hardy and more immune to climatic changes than other cereals, while it does not exhaust the soil as quickly as other grain products. In the warm climate rice is a particularly valuable food, as in the tropics corn and wheat cannot constitute the staple food, owing to the fact that they cannot be preserved from one season to another. Moreover, rice is a healthful, easily digested food, and for this reason it is becoming more popular in all parts of the country.

The area of rice land in the United States is, of course, limited, and the states of Texas and Louisiana enjoy almost a monopoly of land suitable for the perfect growth of this cereal.

In New Orleans home capital has just purchased 7,000 acres of land suitable for rice culture, and it is the intention of the men interested in the company to establish one of the largest and most modern plantations in the state. The land is situated in Vermillion parish. Since the war with Spain the rice business has increased at a rapid rate, this being accounted for by the fact that rice has been found to be of great value as food for army purposes and by the fact that men who have served in the army have taught others the wisdom of including rice in the regular daily diet. Northerners are using rice to a greater extent than ever before.

Successful rice farming requires a warm climate, plenty of fresh water and a clay subsoil that will hold water. Irrigation is necessary in the southern rice fields, and the wise farmer will calculate to use about 13,000 gallons of water for each acre, while he will also calculate to have a complete system of drainage in order to get water off his land as well as on it. The establishment of pumping stations and the building of irrigation canals have revolutionized the industry. At present there exist over eighty of these artificial streams, extending throughout the prairie of southwestern Louisiana. There are miles and miles of irrigation canals fed by pumps which elevate the water from the streams, each canal irrigating anywhere from one to twenty thousand acres of land. The canals are flushed during the growing season and the water is given to the rice just at the time when it needs it most.

Rice is flooded from two to twelve inches, and kept flooded during all of the growing season, until the heads have become filled and the crop begins to ripen, when the levees are cut and the water allowed to run off, thus giving the ground time to dry and harden before har-

vesting time. The harvest season does not differ from the harvesting of wheat or oats in the northern states. After cutting, the rice is allowed to stand in a shock from two to three weeks before stacking, as, owing to the excessive amount of moisture in the straw, it takes longer to dry out than other grain. The crop is harvested at the same expense and in the same manner with self-binding harvesters as other small grain. The yield is about three times that of wheat. Under favorable conditions it produces from twelve to eighteen barrels per acre, the average price for the last ten years being $2 a barrel. Rice growers sell the cereal in the rough to the mills, which take off the hulls and put the polish on the grains. Planting generally begins in March, and it may continue till July, while harvesting may begin in August and last until November. American rice machinery enables one American to accomplish about as much as thirty men do in the far East.

Rice culture in the United States was confined until 1885 to the alluvial lands of the Carolinas, Georgia, Florida and Louisiana. Subsequently it was found that the so called prairie lands of southwestern Louisiana and southern Texas were fully adapted to the growth of rice, and within a short time vast areas of land that had always been considered worthless were made to yield comfortable incomes. The coast rice belt in Louisiana and Texas includes 12,000 square miles of fertile rice land. In most cases irrigation is employed, as rains are infrequent and the proximity of ten navigable rivers makes the chief problem in rice culture an easy one. Canals are run from the rivers to the farms, while in addition the farmers receive the benefit of gravel beds underlying the land, from which large supplies of soft water are obtained. The modern rice mill takes the rice in the rough and turns it out ready for market, graded, sacked and weighed, at the rate of 20,000 to 200,000 pounds a day. With this machinery there is no country where a dollar will produce as many bushels of rice as in the United States. It is estimated that Cuba, Porto Rico and the Philippines will all be large importers of rice from the United States. and that even India, China and Japan will some day need American rice to help feed their increased population. In Texas alone $800,000 (mostly northern capital) has already been invested in the rice industry. According to the statistics compiled by S. F. B. Morse, passenger traffic manager of the Southern Pacific, the Southern Pacific road handled out of southwestern Louisiana 2,000,000 pounds of rice in 1886, while in less than ten years, in 1892, 100,000,000 pounds of rice were produced. Under present conditions the annual rice production in this country is 200,000,000 pounds, but it is estimated that with the present and prospective market this country will soon be able to sell 700,000,000 pounds of rice annually.

REPLANTING NATION'S FORESTS UNDERTAKEN BY RAILROADS.

By John Howard Todd.

Railroads of the United States are taking the initiative in the reforestation of the country. They have undertaken a work which promises to be of vast importance to themselves and to the people at large. One generation hence they will be referred to as the pioneers in practical forest culture. Lumbermen foresee the facts and are giving credit in advance. Forestry associations, racked by many discouragements, are pinning their faith to the great transportation companies. Railroad officials themselves modestly admit that posterity may owe them something on this score.

It is no philanthropic impulse that moves the railroads. Sentiment does not enter into their great project. They are inspired by a cold calculation of the lumber needs of the future and the diminish-supply of to-day, If their enterprise shall make a desert bloom here and influence a more productive climate there, well and good, but what they want is railroad ties. Twenty years hence that need will be acute unless some provision is made to meet the enormous demand.

Friends of forestry are not moved so much by what the railroads actually will do as they are by the reflex influence the work is expected to exert on the country at large in enforcing the truth that the timber supply is not inexhaustible. They believe public sentiment will be aroused as it never has been before; that the federal and state governments will turn their attention more seriously to this great question; that the private culture of forests will be given a wide-reaching impulse; that their dream of a "primeval forest, the murmuring pines and the hemlocks" will be realized with glorious consequences.

Among the great railroad systems which already have undertaken forestry culture or are giving the subject serious consideration are: Illinois Central, Rio Grande Western, Cleveland, Cincinnati, Chicago & St. Louis, Boston & Maine, West Virginia Central, Pennsylvanin, Kansas City, Fort Scott & Memphis, Atchison, Topeka & Santa Fe, Union Pacific, Southern Pacific, Chicago, Burlington & Quincy.

To the average mind a million is beyond comprehension, but if there were one great composite mind directing the railroads of the nation, it would have to think in tens and hundreds of millions on the

cross-tie problem alone. The stupendous draft of the railroads on the timber resources annually is exhibited in the following table:

Railroad ties in use	7,000,000
Average life of tie	7 years
Annual requirement for renewals	112,000,000
Annual expenditure for ties	$60,000,000
Annual forest clearance for ties alone	500,000 acres
Number ties needed for next two decades	3,000,000,000

These figures are on the present mileage basis—something less than 180,000 miles of track with an average of 3,500 ties to the mile. It is roughly estimated that the railroads of the country consume one-ninth of the lumber used. Accepting the figures as approximately correct, the next two decades will witness the clearing away of an area of woodland five times as big as the state of Ohio. Think of the destruction of an unbroken forest 500 miles long and 400 miles wide before 1920 and you have some cenception of the situation with which the railroads and the country at large are confronted. It is this outlook that is stirring the railroads to activity.

Chief among these just now is the Illinois Central, which, a few weeks ago, commissioned John P. Brown, secretary of the International Society of Arboriculture, of which J. Sterling Morton is president, to locate in the South a tract of land best suited for the culture and growth of the catalpa speciosa, a tree indigenous to the lower valley of the Wabash river in Indiana and Illinois. Mr. Brown has fulfilled that part of his mission and brings to the railroad officials the most glowing accounts of the result of his search. He said:

"I have chosen a tract of 175 acres of land near Harahan, seven miles north of New Orleans, for the Illinois Central's first experiment in forestry culture. This has been planted. In that vicinity I find that the growth of catalpa is more rapid than in any other part of the country. Trees planted as late as 1890 have increased to a diameter of twenty-five inches and grown to a height of fifty feet. Each of these trees, I figure, will make ten ties—surely an encouraging result for a matter of twelve years' growth.

The tract in question will accommodate 110,000 trees to be transplanted from a nursery where the seed was planted last spring. This planting will be done as soon as the ground can be plowed and put in order. Ten years hence the road will be getting ties from the tract if it choosef although a wait of a few years longer would be profitable, for in those few years the productive capacity of the trees would be greatly increased.

"What does this movement of the railroads signify to the people generally?

"The possibilities are so great that even I, in my enthusiasm, hesitate to forecast them. If this experiment of the Illinois Central's

be a success—and I think there is absolutely no doubt it will be—the road will devote thousands of acres of land in the vicinity of its right of way to the culture of forests. Other great railroad systems which consume immense numbers of ties will follow the example. What the railroads do on a large scale will be emulated by private parties until the aggregate area devoted to new woodlands becomes larger than any of us now dream of. The state and national governments will fall into line with fostering legislation and a vigorous public sentiment will be aroused, expressing itself not only in restoration but in the better care and preservation of those forests that now exist.

"I don't think I am painting the picture in too glowing colors when I say that future forestation will minimize the vast damage done by the siroccos of the West and that there will be established new climatic conditions of incalculable benefit to agricultural and commercial interests. A few years ago I would have been laughed out of court for such a prophecy, but the doubling of value of many kinds of timber in the last few years is bringing the question of future timber supply home to the people in the most impressive way."

Mr. Brown has been pleading and negotiating with the officials of a number of roads other than the Illinois Central in an endeavor to interest them in forestry culture. Better than any other man, perhaps, he knows what has been done by these roads and what is contemplated by them. He finds that, in the aggregate, something like a million trees have been planted for experimental purposes He says:

"The Rio Grande Western planted 65,000 catalpa trees last spring on a tract of land near Provo, Utah. The trees are on irrigated land. In a year they made a really wonderful growth and the officials of the road are perfectly satisfied with the result of the experiment thus far. It is to be regretted that the Goulds could not have their personal attention called to this particular enterprise. I believe they would consider such an investment the most profitable kind they could make.

"The Cleveland, Cincinnati, Chicago & St. Louis road (Big Four) has a catalpa plantation of 100,000 trees along its line in Indiana. The trees are now two years old and the growth has been satisfactory—so much so that there will be planted several hundred thousand more trees this spring. These trees are in the natural home of the catalpa and all the conditions are favorable for a rapid and healthy growth.

"The Boston & Maine road, which is deeply interested in the subject, will make an experiment with 10,000 catalpas this spring on vacant lands belonging to it in New England. It has been found that the catalpa can be grown successfully in Maine; New Hampshire and Massachusetts, where little was expected of it. The ultimate results

are not certain, however, and I have advised experiments also with chestnut and black walnut trees.

"Sixty-five thousand trees have been bought by the West Virginia Central for transplanting on its vacant land in West Virginia. On this land white oak once flourished and was plentiful, but the supply of it is now almost exhausted. The road expects to use the new timber for mining purposes as well as for ties.

"Twenty-five years ago the Pennsylvania planted 200,000 trees along its right of way. Most of these were of the wrong variety, hence the experiment proved a failure; and it is hard to get the ear of the officials for a new trial under different circumstances. However. I understand the road is making experiments with South American wood, showing it is interested vitally in the subject. Bringing ties so long distance would be expensive even if the right kind of wood were found so I think there may be a turning to this country again when other roads' tests shall prove successful.

"The Fort Scott & Memphis has a plantation of 1,200 catalpas near Fort Scott, Kan. It was planted a generation ago, but did not do well because the trees were crowded too close together. The engineer will thin out the forest this spring and I am sure the investment will yet be satisfactory. The Union Pacific, Burlington, Southern Pacific and Rock Island are manifesting active interest in this question, but as yet have made no extensive experiments."

Wesley Merritt, industrial commissioner of Santa Fe, says his road has not taken up the matter of forestry planting inasmuch as it is supposed to have a fifty years' supply of timber along its line in the southwest. Mr. Merritt states, however, that the experiments of other roads are being watched with much interest and that he is collecting all the data available on the subject of future tie and lumber supply. Thirty years ago the Santa Fe planted a number of small forest patches in Kansas, using several kinds of trees. When the panic of the early seventies came on, these farms practically were abandoned. Recent investigations revealed that the catalpa was one of the varieties that survived.

This catalpa speciosa, by the way. is one of the most interesting trees of the West. It combines in a peculiarly desirable way the qualities of hardihood, rapid growth and durability. It grows to a diameter of two to seven feet and sixty to eighty feet high. It was much used by the Indians because it was at once so strong and so easily wrought. Early settlers followed the red man's example in the use of the wood for their houses, boats and stockade forts. General (afterward president) William Henry Harrison was a strong advocate of the use and cultivation of the catalpa. He said he had seen this wood sonnd and bright a century after it had been placed in a stock-

ade. Along the line of the Evansville & Terre Haute road there are still standing posts of catalpa that have been in the ground fifty years.

J. W. Cooper, engineer of maintenance of way of the Big Four, expresses the view that the catalpa tie in good ballast will last thirty to thirty-five years, whereas the average life of the ties now in use is but one-fifth that number of years. With all its excellence for homely and rude usage, the catalpa takes a polish as rich as that of walnut and cherry. It is not hard to find a grain of striking beauty in the wood.

A desk made of polished catalpa was on exhibition for two months recently in the State House at Indianapolis. It was pronounced the most beautiful desk in the capitol. The tree from which the lumber was taken had grown in twenty-five years to twenty-two inches in diameter and it produced 250 feet of lumber, board measure (twelve inches wide and one inch thick.) Indiana farmers like the wood for plow beams, single trees and tool handles because it is light and durable.

Forestry planting by the railroads was an informal subject of much interest at the recent meeting of the National Wholesale Lumber Dealers' Association in Chicago. John J. McKelvey, general counsel for the association, is particularly well informed on the subject of the lumber situation. He said:

"It is quite clear that the future of the lumber industry will depend upon the success in establishing some intelligent system of forest care and culture."—*From the Brooklyn (N. Y.) Daily Eagle.*

AGRICULTURE.

MOOSE MOUNTAIN DISTRICT, WESTERN CANADA.

In preparing an article on the Canadian Irrigation it was thought well to call attention to the famed Moose Mountain District, which has come into great prominence during the past few years.

This District needs no particular introduction to the people who have been interested during the past year in farm lands in the Canadian West.

A large amount of advertising and work has been done in connection with this territory by the American Colonization Company of Ottawa, Ill. This firm realized the great possibilities of the Moose Mountain territory and immediately secured control of large bodies of land, and it is said that they now practically control nearly one million acres in that country.

We are presenting illustrations furnished by this company, one showing a harvesting scene, another harvesting a potato crop, and still another giving an idea of the appearance of the homesteads in that country.

This past year and a half over 2,500 persons have taken up homesteads in this District and nearly one-half of these are now resident farmers. The year 1902 will exceed all others in the line of immigration from England, Ireland, Scotland, Ontario, Quebec, and all parts of the United States. To the north rise the Moose Mountains and from the elevation of this pretty range can be seen the long fertile valley to the south extending sixty or seventy miles east and west. From this range of mountains the whole district gets its name.

The soil throughout the district is of a very high quality, being a rich black clay loam on a clay subsoil, and is admirably adapted for the growing of hard wheat. The water throughout the entire district is of the finest quality and is to be obtained almost everywhere at an average depth of from 10 to 20 feet. In a great many places, especially along the small creeks which flow from the mountains, live springs are to be found of pure crystal water. About the center of the district and running from the northwest is the Moose Mountain creek, a splendid stream of fresh water, which runs the year round and furnishes a constant supply of water for cattle or other purposes.

The mountains, which bound the district to the north, are thickly wooded and supply an unlimited quantity of feed for cattle. There is an abundance of all kinds of native grasses, including red top and wild peas, which varieties are considered by the cattle men to be the best adapted for feed purposes. In the heart of the mountains the government has a large area of the best timbered land set apart as a wood reserve for the use of the settlers, who can obtain a free permit to cut the following amounts of timber for fuel for use on their land; 3,000 lineal feet of building timber, 400 roof poles, 500 fence posts, 2,000 fence rails, and a sufficient quantity of fuel for domestic purposes. The mountains are not of use for timber alone, as large herds of the farmers' cattle graze quietly on the hills from spring until fall, at no cost to their owners. About the end of October the herds are rounded up and the cattle selected for the eastern markets. The beef cattle from the Moose Mountains are not surpassed in either size or quality by any other cattle in America.

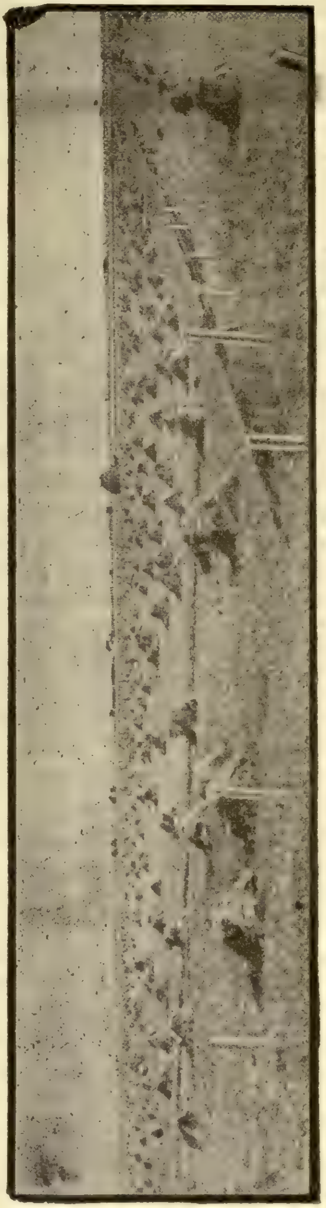
Although there is an abundance of wood to be had in the mountains there is very little, if any, timber on the prairie. An abundance of hay scattered throughout the entire district in the sloughs affords food for the cattle and horses throughout

the winter. As yet there has been no hay cultivated, as the supply has been sufficiently great to fill the demand. Should a shortage occur the farmers have large hay meadows in the mountains from which could be taken enough hay to supply all Eastern Assiniboia. On all lands belonging to the Dominion government a settler is allowed to cut hay for his own use provided he takes out a permit at a cost of ten cents per ton.

The farmers of the district are among the best to be found on the American continent and are in a good healthy state of prosperity, as will be understood when it is said that we have a very large number who came in a few years ago without any money, but with plenty of energy and perseverance. Many of these are now in easy circumstances, with rich farms and good comfortable homes and plenty of stock and other things which make life pleasant on a farm.

The Moose Mountain district has been to a considerable extent under cultivation for the past twenty years, yet it was not until the fall of 1900 that the first train began running in. The development of the district has been marvelous. For the season of 1901 up to the present time there has been over 900,000 bushels of wheat shipped out, besides several thousand bushels of other grains.

The principal crops raised in the district are wheat, oats, barley and flax. The wheat crop has averaged over twenty bushels to the acre for the past twenty years and over seventy bushels of oats, and the season just passed the wheat in several cases has gone over forty bushels to the acre and oats ninety bushels per acre. These are big yields, but are not considered by the old settlers here to be beyond what has been reaped in the past. The soil is strong and rich and capable of bearing still heavier crops when the proper care is taken in the cultivation of the land. Flax was not grown much until the past year, and in the only instance which came to the writer's notice where flax alone was grown the yield was twenty-one bushels to



HARVESTING SCENE IN THE MOOSE MOUNTAIN DISTRICT.

the acre. In another case, that of Mr. John Mears, an American who came in here last year, he grew thirty-five acres of wheat and flax mixed together on the same

field and the crop harvested was eleven bushels of flax and twenty-six bushels of wheat, to the acre, both well developed and splendid samples.

There are a great many free homesteads yet to be taken up on the line of the proposed railway, and the homestead laws are such that any person who is entitled to a free homestead can fulfill his duties without residing upon the homestead, provided he owns and is occupying other farm lands in the vicinity, or in the case of a son living on farm land with his father, the requirement as to residence may be fulfilled by him residing with his father. In all other cases the party taking up a homestead is required to reside upon his homestead for six months in each year for three years, and to do a reasonable amount of cultivation.

Those who are entitled to free homesteads are any male who is the sole head of a family, or any widow who is the sole head of a family with minor children depending upon her, any male who is 18 years of age, provided none of the above have ever had a homestead on Dominion lands except in the case of anyone who has had his Patent of Certificate of Recommendation for his patent previous to June 2, 1889.

After a homesteader has entered upon his homestead he is allowed six months in which to complete his entry by commencing to reside upon his land. In case he does not commence residence within the time limited, his homestead is liable to cancellation by any person who files an application. In case there is an application to cancel filed, the party who holds entry is immediately notified and is allowed sixty days in which to show cause why his entry should not be cancelled. If he does not show cause within the time limited his entry is cancelled and the party who applied for the cancellation is notified that he has twenty days in which to file his entry for the land.

ALFALFA GROWN IN MOOSE MOUNTAIN DISTRICT.

The cost to make entry for a homestead on Dominion lands is $10 for a quarter section of 160 acres, and no person is allowed to homestead more than this amount.

Persons coming into Canada from the United States or other foreign countries do not require to become naturalized in order to take up a homestead or buy land in the Dominion. At the end of three years and before a patent or deed for their homestead can be granted, they will require to become naturalized. In all other cases a deed may be procured at the time of purchase.

etc. The taxes on an ordinary farm of 160 acres in the most thickly settled districts, where the best school privileges are enjoyed and the best road and general improvement work is carried on, is about $5 on the quarter section. These statements speak for themselves and appeal to the average farmer who has been handicapped in so many cases by the excessive taxes imposed.

The climate here is all that can be desired, as it is blessed with a beautifully clear sky and dry, bracing atmosphere. In the spring, which generally opens about

POTATOES GROWN IN MOOSE MOUNTAIN DISTRICT.

The public school system is all that can be desired, as according to the laws of the northwest territories in any community where there are seven children between the ages of six and fifteen years a school can be demanded, and the government pay 70 per cent of the cost of maintenance.

The northwest territories of Canada is perhaps the lightest taxed country on earth. There is absolutely no personal tax, road tax, no tax on bonds, mortgages,

the first of April, the days are most delightful. The heat of the summer season is much alleviated by the calm, cool nights. In the winter the thermometer sometimes drops down below zero, but with the bright sun the cold is not distressing. Persons coming from the Southern States, Eastern Canada, and even from the British Isles, do not find the climate disagreeable. Horses graze on the prairie all winter and are brought in about March in

good condition. Cattle graze in the daytime and in many cases are housed for the night. The climate here must be experienced to be appreciated.

The Moose Mountains are fast becoming a much frequented summer resort, having a number of small lakes throughout the hills, fringed about with a dense growth of heavy timber. In some of the lakes fish are very plentiful and afford the finest sport for the angler, where one can catch as many as fifty to seventy-five fish, mostly pike and pickerel, in a single hour with rod and line. On the lake known as Fish Lake there are two summer hotels and a large number of private cottages built by parties who annually spend the hot season of the year at this resort. On the lake are a number of gasoline launches and sailing boats, besides a large number of row boats, which can be hired by the day or hour. Wild game is very plentiful, including elk and small deer, wolves, foxes, rabbits, partridges, ducks, etc., in the mountains, and wild geese, turkeys, ducks and prairie chickens in abundance on the prairies.

The cost of living in the Moose Mountain district is perhaps less than any other district in the American or Canadian West. Wood in the mountains near by and coal at a distance of from thirty to sixty miles ready for loading on wagons at $1 per ton, make the fuel question an easy one. Farm produce always brings a good price at any season of the year, and in nearly every case can the average farming family be maintained by the butter, eggs, and general smaller products of the farm. Timber for building is obtained free and the large saw mills of Lake Superior and the Rocky Mountains keep lumber at a normal price.

We could give many examples of the splendid results that have been obtained by the persevering and industrious men who came to this district a couple of years ago. In cases where land was purchased for $8 per acre, with a small payment of $150 down, the farm now is clear and other land has been added. The prospects were never brighter, and with the natural wealth of our very fertile district the farmers here will in a short time be among the wealthiest in the North American West.

In the center of the district stands the new and thriving town of Arcola, laid out in the fall of 1900, and now with a population of about 500, with over forty places of business. Here is established a sub-Dominion land office where all business in connection with Dominion lands can be transacted. Mr. A. B. Cook is in charge. There are three standard grain elevators and good stockyards, also a chartered bank. The Canadian Pacific railway has its terminal here with first-class station-house, and round-house large enough to accommodate four engines. Almost every line of business is represented. The erection of a large flour mill is now being considered and undoubtedly one will be established within a short time. Five hundred thousand bushels of wheat were marketed in Arcola this season.

For further information about this marvelous country write the American Colonization Co., Ottawa, Ill., and they will furnish you a lot of finely illustrated printed matter free, including the opinion of James J. Hill on the future of the Canadian northwest.

TALL MEADOW OAT GRASS.

The prosperity of our country depends largely on the growth of grasses. That we are not giving as much attention as we should to the pastures and meadows is shown in the census report for 1900. During the past ten years the population has increased 22 per cent, while the increase in beef and mutton, milch cows and sheep has not averaged over 10 per cent. This failure of the farmers to keep pace with the increasing population of consumers is due largely to the decrease of grasses and the natural falling away of farm animals.

One-sixth of the country should be in some kind of the 800 varieties of grasses grown for feeding stock. Of the numerous varieties that possess remarkable value the Tall Meadow Oat is probably one of the very best to plant.

This grass is also known as French Rye, and is found in almost every mixture of meadow seed supplied by the experienced statesmen. It is a magnificent grass, often reaching four feet in height, and coming on earlier than most of the hay grasses. It may be cut three times in a season, and will furnish more good, clean hay than a similar crop of timothy. It is a perennial, and practically an evergreen food in the South, where stock find it green every month of the year. Being deep rooted it withstands drouth fairly well, and is not killed by winter frosts. When cut for hay it cures quickly and packs in the stack well. All kinds of stock relish the green grass and the cured hay.

The oat grass does well on any soil where similar grasses are sown. Good crops may be taken from light, sandy loam, and also from the clayey soils. It is a good upland grass, has a pretty tuft of roots, and will hold the soil from washing. Like all other grasses it needs the best soil to produce satisfactory results. It should be topdressed with a good fertilizer containing at least 8 per cent each of potash and phosphoric acid, if used for meadow exclusively, and when wanted for both pasture and a hay crop nitrogen should be added at the rate of 3 per cent. Such plant food should be put on the land in the spring, using from 600 to 1,000 pounds per acre. Another good mixture would be about 100 to 150 pounds of muriate of potash and from 400 to 500 pounds of ground bone per acre, applied early in the spring before growth starts up, as a top dressing. If the grass is mixed with some of the legumes it will require only potash and phosphoric acid.

Oat grass gives better results in the southern states by sowing in early autumn with a mixture of seeds. The proportion is about two parts orchard grass, two parts Tall Meadow Oat, and one part either red or alsike clover. For this mixture about 25 pounds should be sown to the acre. If sown alone, the oat grass will require 30 to 40 pounds of seed to the acre. September and October are good months for general sowing, though some prefer to sow about the last of August. The soil should be well prepared, by summer plowing and harrowing, to insure a good seed bed. The seed may be purchased of all dealers at about 15 cents a pound, or $2 a bushel of 14 pounds.

For hay the oat grass should be cut when in blossom and before the seed ripens. It will come on in early spring and if not pastured will be ready for cutting at the South in June. After mowing, the grass should remain in the swath long enough to cure, and be put in winrows or cocks without rain or dew falling on it. As it stacks closely there should be some salt used on each wagon load. If placed in the barn it will keep fresh and may be fed without any waste. Stacks do better if covered with cloth to keep out rains and snows. In feeding this grass the best results are obtained by mixing with other forage or solid foods. It is exceptionally fine for dairy cows and all confined stock. If more of this grass is sown, we will have more than 4 per cent of an increase in dairy stock during the coming ten years.

JOEL SHOEMAKER.

North Yakima, Wash.

IRRIGATION.

GREAT IRRIGATION SYSTEM.

According to the Texas *State Journal* the largest irrigation system in the United States, and one of the best in the world, is in Chaves and Eddy counties, in southeast New Mexico. These are, in fact, four combined systems, three of which lie in New Mexico, and the fourth just across the line in Texas. The main canal of the latter will be 42 miles long. The three systems in New Mexico are known as the North canal, the South canal and the Hagerman. The North canal is more than 35 miles long, and with its reservoir of 2,000,000,000 cubic feet capacity is expected to meet all demands of 100,000 acres of land. The South canal, in its two parts, is some sixty miles or more in length, has three reservoirs of 10,300,000,000 cubic feet capacity, and is considered as more than sufficient for 200,000 acres. The aggregate for the three systems is 1,294 miles of canals and ditches, and 13,000,000,000 cubic feet of storage capacity, completed and projected, ample to reclaim 500,000 acres of adjacent land. The systems cost $3,000,000 and have resulted in the building of the Pecos Valley & Northeastern, a standard guage railroad, 372 miles long, to ship products irrigation has produced.

IRRIGATION IN BIG HORN.

S. L. Wiley, formerly of Omaha, but now at the head of one of the irrigation companies in the Big Horn basin, in a recent visit to Cheyenne, Wyo., tells of the work being done in the Big Horn country, looking to the reclamation of the arid lands there.

Four years ago the Big Horn Basin Development Company filed on 14,000 acres under the Carey act and constructed a canal for irrigating purposes. The lands are at Germania, near Garland, and the colony is two-thirds settled, about 200 thrifty people being there now.

But this colony is an infant compared with many others doing business in the Big Horn country. To date there have been applications for 250,000 acres in the Big Horn basin, all taken under the Carey act.

A natural reservoir has been discovered there that is a wonder. It is three miles by four in dimensions and has a water line of 13 miles. It is 97½ feet deep at the deepest point and will contain 400,000 acre feet. Nature has carved out this big basin with massive sides of solid stone, and absolutely no masonry will be required except for an outlet.

The Big Horn river would be the base of supply, and as this stream is navigable and runs an immense volume of water, the huge reservoir could be filled with little difficulty.

A tunnel 8 feet in diameter by 12,000 feet long would carry off the water to the thousands of acres of fertile land below.

THE ARTESIAN WELL.

An Indiana paper says that the artesian wells have been the salvation of the semi-arid portion of South Dakota, the supply of water drawn from them being ample to supplement the deficiency in rainfall. Thus far there is no sign of failure, in spite of the heavy drafts made upon the subterranean rivers. The same reports come from localities in regions farther west, where there is little rainfall. There is sometimes a tendency to drouth during some seasons of the year in this and adjoining states, and artesian wells might possibly be made useful in Indiana. It would be a great thing to be able to get a supply of water from the depths of the earth when the clouds deny it.

IRRIGATING POTATOES.

The University of Wyoming has issued a bulletin on the effect of different amounts of water used in irrigation upon the yield of potatoes.

The yields from Plats A, B and C in 1900 were 1,176, 2,230 and 3,069 pounds per acre respectively, and the corresponding depths of water received by the plats from irrigation and rainfall were approximately five, seven and ten inches. In 1901 the yields on the respective plats were 3,332, 3,956 and 5,432 pounds per acre, and the corresponding depths of water 17, 18 and 48 inches.

For both seasons the plats receiving the largest amounts of water gave the largest yield of marketable tubers and the greatest total weight.

Of course, the results for these two seasons are by no means conclusive. The amount of water which one plat received sufficient to have covered it to a depth of three and one-half feet seems enormous, yet this plat produced the largest yield of potatoes, and the difference in the table qualities of the potatoes from this plat and from those receiving smaller amounts of water is said to have been perceptible.

A LARGE COMPANY.

The Northwestern Irrigation Company is now being organized. The paid up capital stock is $225,000, most of which is northern capital. This company is headed by Albert Anderson, the successful rice farmer of Jennings, Tex.

Seventeen thousand acres of the K. O. Range between El Campo and Bay City has been purchased. The pumping site of the Planters' Irrigation Company on Colorado river has been bought, making an easy water lift.

Contracts for macinery, farm buildings and canals are now being let. Six thousand acres will be put in rice for 1903 and the company has already received many applications from tenants who want to rent land. The land is high and considered to be the finest rice land in Texas. Mostly Scandinavians are wanted. At least twenty-five tenants from Minnesota and Dakota will settle on this land.

TO RECLAIM BABYLON BY COLORADO METHOD.

Baron von Oppenheim, commissioner from Germany to investigate western irrigation, has completed a tour of northern Colorado and is enthusiastic over the application of water from the mountains and the results derived. He praposes to adopt the same form of storing storm water for the reclamation of the valley of Babylon, which is largely owned by German capitalists along the line of a railroad under construction from Constantinople through Bagdad to the Persian gulf. Upon the site of Babylon there is now being built a small city which will be touched by the railroad, and Baron von Oppenheim believes that once the water is stored and again turned into the canals the land will become productive and resume its former prosperity.

ARTIFICIAL WATERING.

When water is applied to fields artificially it should generally be done late in the day, where the operation is not of great magnitude, in which case this matter of time cannot always be controlled. The soil being wet at night, absorbs the water thoroughly before another day. It is applied in the morning when the sun is hot, evaporation sets in and a crust is formed by the particles being drawn close together. This in turn has to be broken up. It is desirable to prevent this, for it not only causes loss of water, but the crust acts as a barrier to the entrance of air into the soil. This holds good in the case of crops that do not cover the soil. Of course if the soil is well shaded the application of water can be made at any time of day, without regard to the volume or intensity of solar heat.

IN ARIZONA.

Arthur P. Davis, of the government geological survey, is making a preliminary survey for a canal from Bull's Head to a point in Mohave valley, below the town of Fort Mohave. The canal will pass through the high mesa back of Hardyville, and will reach about fifty thousand acres of the finest land in Arizona. The building of this canal would open up to settlement this large tract of land, and be the means of increasing the population and taxable wealth of the county many fold.

IRRIGATION NOTES.

The Atchison, Topeka & Santa Fe railway is soon to issue an attractive book descriptive of the irrigated sections in the Pecos Valley of New Mexico.

The Pecos Irrigation Co., Carlsbad, New Mexico, is to replace its wooden flume across the Pecos river with a new steel and concrete flume, the estimated cost of which improvement is to be $50,-000.

The Rio Grande Land and Improvement Co., with a capital of $5,000,000, has recently been organized for the purpose of irrigating a large amount of land in the vicinity of El Paso, Tex. The source of water supply is from the Rio Grande river and from wells.

F. H. Newell, chief hydrographer, United States Geological Survey, passed through Chicago, July 17, en route to Denver, Colo., where he is to be the guest of the Chamber of Commerce. M . Newell will also visit Phoenix, Ariz., and other points in the irrigated sections of the southwest.

H. J. Page of Denver, receiver of the Manvel Canal, has just completed considerable work upon that property. This canal has its head gates on the south side of the Arkansas river and takes water out of the river about sixteen miles west of Granada, Colo. The canal waters about 4,000 acres of land at present.

Prof. Charles S. Slichter, of the University of Wisconsin, assigned to the United States Geological Survey, is at present in California making a survey of the underground waters in the vicinity of Los Angeles. Prof. Slichter is the originator of an electrical method of determining the velocity of underground waters.

Considerable interest is being manifested in the development of the underground water of the Rio Grande Valley in New Mexico. A very interesting demonstration of the volume of underground water was recently made in the vicinity of Albuquerque by Mr. Paul B. Perkins of Chicago, and a number of experiments are being carried on by the New Mexico College of Agriculture at Mesilla Park.

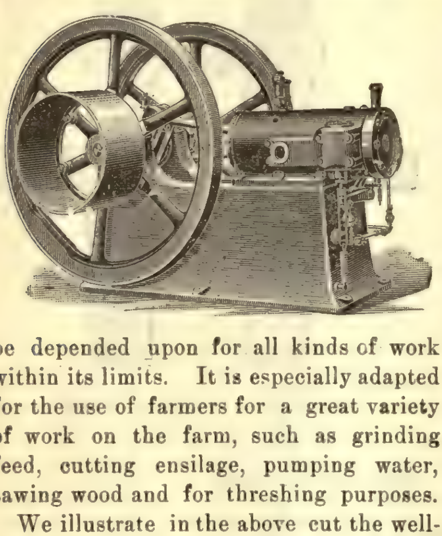
The Texas Land and Irrigation Company has been organized with a capital stock of $2,000,000, having as its object the construction and operation of an irrigation canal starting in Austin county, Texas, on the Brazos river, to irrigate for rice raising one of the richest bodies of land in the South. It is estimated that several hundred thousand acres of land will be watered by this system. Surveys show the land to have a fall that could hardly be better, nearly fifty miles of surveys have been made, deeds delivered to right of way, and construction commenced.

Lowell G. Lloyd, of Denver, Colo., has returned from the East, having concluded the organization of the Boyd Lake Irrigation Co., with a capital of $250,000 which will push the work upon the reservoir at Boyd Lake, Colo. This enterprise has its center near Loveland, Colo , and Boyd Lake is said to be the only reservoir in Northern Colorado that will draw water from two water sheds, the Cache la Poudre and the Big Thompson. The basin is four miles long, three quarters of a mile wide, and has a capacity of 2,000,000,000 cubic feet of water. Engineers are now upon the spot surveying for the work.

MISCELLANEOUS.

THOMPSON-LEWIS GASOLINE ENGINE.

The use of gasoline engines for a great variety of purposes requiring a limited amount of power is becoming more and more popular year by year. The public is finding out that a first class gasoline engine is a strictly reliable machine, and can



be depended upon for all kinds of work within its limits. It is especially adapted for the use of farmers for a great variety of work on the farm, such as grinding feed, cutting ensilage, pumping water, sawing wood and for threshing purposes.

We illustrate in the above cut the well-known Thompson-Lewis Engine, which is one of the high grade, standard engines. This engine has been on the market for about ten years, and has been thoroughly time-tried and tested. It is one of the simplest engines in the field. It has very few parts, and these parts are simple in arrangement and designed for ample strength. The engine is heavy in weight, made of the very best materials, nothing but phosphor bronze bearings are used.

The main distinguishing feature of this engine is the volume governor, which controls the speed of the engine on the same principle that the governor of a good steam engine does. It regulates or controls the amount of gas taken into the ylinder according to the load, thus the engine will at all times run with a perfectly uniform and steady motion, producing less wear and tear on the engine itself, and also on the line shaft, pulleys and machinery run by the engine. The other type of hit-and-miss governor used on most gasoline engines is a constant source of trouble and annoyance, as it produces violent explosions in the engine and jerks pulleys loose on the line shaft and machinery.

Another excellent feature of the Thompson-Lewis Engine is the Acme Mixer for producing a perfect mixture of gasoline and air, thus rendering the engine very economical in its operation.

The Thompson-Lewis Engine is also provided with double exhaust ports, taking away all back pressure on the piston.

If you are considering putting in a gasoline engine we would recommend all readers of this paper to write to the manufacturers, J. Thompson & Sons Mfg. Co., Beloit, Wis., for catalogue and full information. It is best to state the work required to be done and the estimated amount of power needed.

In another column will be found an advertisement of the Big Four Mines, Rossland, British Columbia. This company is organized and working differently from the majority of concerns, as with the exception of postage, printing, advertising and taxes, every dollar received from the sale of stock is used for developing the company's property.

Mining experts predict great things for the Big Four group. A prominent western mining man stated a few days ago to the writer that he would not be surprised to see Big Four stock sell for $50 per share He based his opinion on his knowlede of the Le Roi property which adjoins the Bg

Four on the east, and which has been such a large dividend payer.

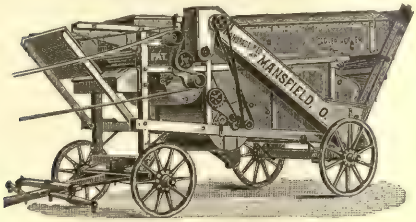
Read over this advertisement anyway and if you want more information, write James Lawler, secretary and manager, Rossland, British Columbia. Mr. Lawler is a mining man of wide experience, strict integrity and splendid ability in his line.

WORDS OF PRAISE.

The following are two of the many testimonial letters received by the Aultman-Taylor Company in praise of their clover huller.

GRINNELL, Kan., Jan. 4, 1902.

DEAR SIRS: I wish to say that the Matchless Huller I bought of your traveling agent, Mr. George Schaefer, is a dandy. It does the finest work I ever saw



CLOVER HULLER.

done. On December 24th I threshed and cleaned 105 bushels of alfalfa seed and on January 2d threshed and cleaned in fine shape 150 bushels of alfalfa seed. With best wishes for you and the Matchless, I remain, Yours truly,

J. H. PUGH.

GENTLEMEN: I have been threshing just one week to-day with my new outfit, consisting of 12-horse Eureka Engine and No. 3 Matchless Alfalfa Huller, and I take pleasure in writing and informing you that the rig has given myself and customers the best of satisfaction, and as to cleaning and saving the seed it has no equal.

Yours very truly,

THEO. TELLESEN.

LITERARY NOTES.

We are in receipt of Bulletin 67 from the Colorado Experiment Station at Fort Collins. H. N. Haynes writes interestingly of "The Distribution of Water-Powers and Duties of Irrigation Officials under Colorado Laws."

One of the most amusing tales in the fiction number of *Scribner's* is told by Mary R. S. Andrews. A distinguished Bishop and an eminent Judge furnish the entertainment for a small boy, Bob, who narrates the adventure.

A former United States Minister to China, Hon. Charles Denby, comments in the July–September *Forum* on the recent Senate debate on the Chinese Exclusion Bill, and discusses the principal considerations that should be regarded in all legislation of this nature.

It is difficult to imagine a better balanced selection of domestic matter than is found in the July *Delineator*, adapted as it is to the trying needs of hot weather Housewives will appreciate especially the suggestions contained in Summer Salads and Cheese Dishes, the chapter on mayonnaise, the recipes for preparing cherries and the directions for hot weather beverages. In addition is an article useful at any season on braising, frying and sauteing meats.

HOW THE CHINESE GET RAIN.

It is one of the peculiarities of the Chinese that, while they have developed elaborate philosophies, none of them have led to any confidence in the uniformity of nature. Neither the people nor their rulers have any fixed opinion as to the causes of rainfall. The plan in some provinces, when the need of rain is felt, is to borrow a god from a neighboring district and petition him for the desired result. If his answer is satisfactory, he is returned to his home with every mark of honor; otherwise he may be put out in the sun, as a hint to wake up and do his duty. A bunch of willow is usually thrust into his hand, as willow is sensitive to moisture.

Another plan in extensive use is the building of special temples in which are

wells containing several iron tables. When there is a scarcity of rain a messenger starts out with a tablet, marked with the date of the journey and the name of the district making the petition. Arriving at another city he pays a sum of money and is allowed to draw another tablet from the well, throwing in his own by way of exchange. On the return journey he is supposed to eat only bran and travel at top speed day and night. Sometimes he passes through districts as greatly in need of rain as his own. Then the people in these places waylay him and, temporarily borrowing his tablet, get the rain intended for another place.

Prayers are usually made in the fifth and sixth months when the rainfall is always due, and a limit of ten days is set for their effective operation. Under such conditions rain usually falls during the prescribed time. When the prayers are in progress the umbrella, among other objects, comes under the ban. In some provinces foreigners have been mobbed for carrying this harmless article at that time.—*New York Commercial Advertiser.*

The interior department has set aside a new forest reserve, which takes in a very large portion of northern and central Arizona. Commencing at the 40 mile railroad land limit the reservation extends southward to the Salt river valley Indian reservation; the eastern boundery is the line of the White Mountain Indian reservation; Bigbug and Ash creeks constitute about the western boundary of the new reserve. Much of this land is purely agricultural and has never been covered by a growth of trees. It is surmised that proposed government reclamation of arid lands by water storage has some bearing on the creation of this vast forest reserve—*Prescott, Ariz. Courier.*

LAND ON YOUR FEET.

You take a cat up by the tail, and whirl him round and round,
And hurl him out into the air, out into space profound,
He through the yeilding atmosphere will many a whirl complete;
But when he strikes upon the ground he'll land upon his feet.

Fate takes a man, just like a cat, and, with more force than grace,
It whirls him wriggling round and round and hurls him into spoce;
And those that fall upon the back, and have not strength to rise,
Are those short sighted creatures who *forgot to advertise!*

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Factors in steer fattening—final results.
Counsel in the feed lot.
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Station tests with feeding stuffs for dairy cows.
Influence of feed on milk—wide and narrow rations.
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Feed and care of the dairy cow.
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Experiments in fattening sheep—wool production
General care of sheep—fattening.
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Value of various feeding-stuffs for pigs,
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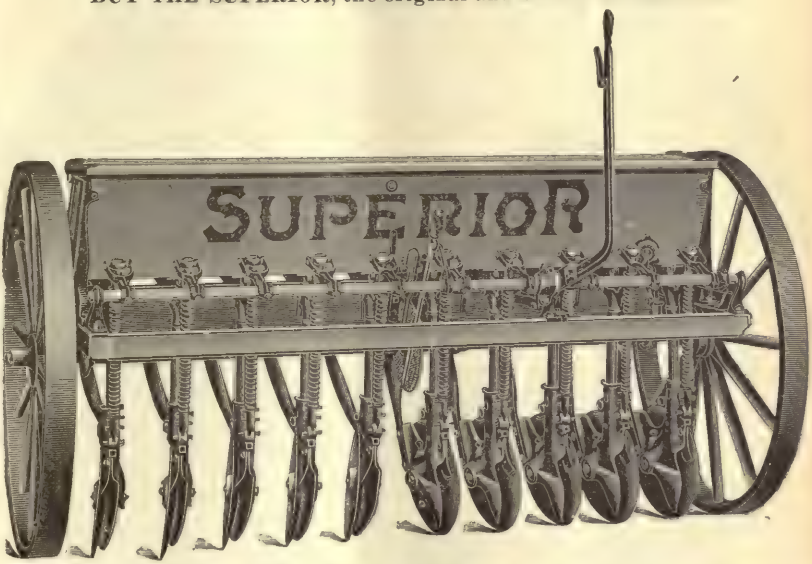

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THE IRRIGATION AGE.

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THE IRRIGATION AGE.

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D. H. ANDERSON, - - Editor.

Elwood Mead. Elwood Mead, whose portrait appears as a frontispiece in this issue, was born at Patriot, Ind., in 1858; he graduated in the engineering department of Purdue University in 1882, receiving the degree of M. S. in 1884, and a degree of C. E. in the Iowa State Agricultural College at Ames in 1883. From 1882 to 1884 he was the professor of irrigation engineering at the State Agricultural College of Colorado; he resigned his position to accept the place of assistant state engineer of Colorado, under the late Col. E. S. Nettleson; after Mr. Nettleson severed his connection with the state, Prof. Mead returned to the State Agricultural College at Fort Collins, from which place he was called to fill the position of territorial engineer of Wyoming in 1888. With the admission of the territory to statehood he became state engineer. The provisions of the state constitution regarding the control and division of water were largely framed by Professor Mead. The state law carrying out these provisions was almost entirely prepared by him. During 1898 he was appointed irrigation expert in charge of irrigation investigations of the United States Department of Agriculture, which position he still holds, now being known as chief of irrigation investigations. While occupying these positions of trust and honor he has at the same time been consulting engineer for a number of large canal and irrigation companies. In 1890 he performed valuable services for the Bear River Canal in Utah. During 1896 he was consulting engineer for the West Side Canal in southern Wyoming and northern Colorado, and during a large part of the time since that year he has

been consulting engineer for the Cody Canals in northern Wyoming. The engineering ability and judicial qualifications he exhibited while state engineer of Wyoming would alone place him at the head of the administrators of irrigation law. Under the system which he inaugurated in that state the irrigator has been so protected that litigation over water rights is practically unknown. Professor Mead has lately delivered a course of lectures on Irrigation and Forestry at the University of California and will deliver another course next year, and under his auspices a department on these subjects was inaugurated April 1 at the university.

Tenth National Irrigation Congress. We are indebted to Mr. C. E. Wantland, of Denver, Colo., chairman of the National Executive Committee, for the following regarding the next irrigation congress:

"The Tenth National Irrigation Congress which will meet in Colorado Springs on October 6th to 9th, 1902, will, it is believed, prove to be the greatest convention ever held in the west. The first National Irrigation Congress, held at Salt Lake, started the agitation which finally resulted in the passage of the National Irrigation Act—the greatest piece of constructive legislation secured for the west since the homestead law. This legislation was secured by the united action of western senators and congressmen—regardless of politics—backed by broad-minded eastern men and with the active support of the president.

"As it provides that hereafter the proceeds from the sales of public lands, within the states affected, shall be devoted to the reclamation of arid lands, it forces to the front the importance of the public land question.

"The interest which many business men of the east have taken in the National Irrigation movement since the Chicago congress of 1900 has been remarkable, and a great responsibility is now placed upon the men of the west in connection with the operations of the Irrigation Act. About five millions of dollars are already available for the work of surveys and irrigation construction. Many problems must be solved before a great deal of work which is really needed can be undertaken, and at the Colorado Springs congress it is expected that the irrigation experts of the country will be on hand to discuss the National Irrigation Act—its operations and possibilities; and many business men from the east will be in attendance to prove their interest in the development of the west.

"The importance of *forestry* is being recognized now as never before, and we must grapple with many problems now being presented in connection with forestry legislation. The American Forestry Association will meet with the National Irrigation congress.

"*Colonization* has been neglected at irrigation conventions heretofore. It is to be hoped that at the Colorado Springs congress colonization work for the arid west will be discussed thoroughly, and such action recommended as will secure an improvement upon existing methods.

"*Harmony* in the west is essential concerning the operations of the Irrigation Act in order that all our friends in the east, who have supported our efforts, may realize that the agitation in favor of national irrigation has been from a broad stand-point, and not because of selfish local interests.

"Colorado Springs is noted for its attractions. The committee in charge is arranging for entertaiments for the delegates which will be unique and satisfactory, and the executive committee of the congress will present a program which we believe will attract great attention. Many men of national reputation will address the convention, and with '*Forestry, Harmony* and *Colonization*' properly handled, the

Colorado Springs congress will surely prove to be a great success."

A Well-Known Advertising Man. Herewith is shown a portrait of Mr. John E. Poor who has recently purchased an interest in the Nolan Publishing Co., Philadelphia, Pa. Mr. Poor is one of the best known advertising men in the country and has had large experience and good training among the advertisers of agricultural implements and accessory lines throughout the United States, and is eminently qualified to fill the important position which he will occupy as western manager for the Nolan Publishing Co.

The publications under the ownership of this corporation are *The Implement Age*, *The Export Implement Age*, *The American Fertilizer*, *The Carriage Monthly*, *The Export Carriage Monthly*, and *The Farmers Almanac*. All of these publications are standard and will no doubt show marked growth under this new arrangement.

Mr. Poor's office will be at 1212 Tribune Building, Chicago. It has been stated that Mr. Nolan has disposed of his stock holdings in the company to Mr. Poor, so that the stock is now in the hands of the three Ware Brothers and Mr. Poor.

The old saying, "Only live fish swim up stream," is well illustrated in the career of John E. Poor, whom we introduce through the medium of his photograph to those of our readers who have not met the gentleman.

JOHN E. POOR.

A Chance to Earn a Home. This being an age of progress it is fitting that in all enterprises old-fashioned methods should give way to improved ones. This is as true of canal building as of anything else. The rule has been for canal companies to let the work of constructing an irrigation ditch or canal to contractors. These contractors hire men who have no interest in the enterprise beyond their daily wages, and who, when the work is completed, leave for here, there and yonder, and the problem of getting settlers to locate along the canal is still to be solved by the irrigation promoters. It seems this might be vastly improved upon if, instead of allowing contractors to hire whom they chose, the canal company would offer to some of

the thousands of men who desire homes, but have no means with which to purchase them, a chance to convert their labor into land. As an advocate of this theory expresses it, "Offer these desirable men good wages, payable one-third cash and two-thirds credited on their perpetuity water-right account, and there will be more good men to accept than can be employed, and the canal enterprise will be on a sound paying basis from the hour of its completion." He further suggests that "the work be given to settlers on the lands who contract with the canal company for water-rights and to none others." This seems a very practical plan. It secures settlers and therefore guarantees success to the canal enterprise, and at the same time furnishes an opportunity for men to obtain farm land in exchange for their labor—their only asset.

Serious Charges. The July issue of the *Rural Californian* in an article regarding the recently passed irrigation bill, has some very pointed remarks to make concerning Geo. H. Maxwell and others. It says in part: " . . . . and the *Rural Californian* hopes that the secretary of the interior will carefully watch, above all, that the land-grabbers and political wolves who have been howling for a piece of meat from the sale of public lands, shall be stopped at the commencement of this great enterprise. Above all, keep this fellow, Geo. H. Maxwell and his crowd away from the treasury; they do not practice irrigation except in front of the bar. Give honest men a chance who are interested in the welfare of home-seekers and farmers, and not the bullying, so-called attorney who has bled the poor fruit-growers to death, in making them believe that he would relieve them of the burdens under the Wright act, and never gave to those poor distressed farmers anything but a receipt for their hard-earned money he received. The Lord save us from such cattle."

A journal making such insinuations as the above should be prepared to verify them.

Stricken Australia A news letter from Sidney, Australia, states that "the great question of water conservation and irrigation on a comprehensive scale has at last taken firm hold of the public mind in at least three of the Australian states. Several causes have contributed to this—the protracted character of the drouth, which has lasted since 1895 and cost $150,-000,000 in cattle and sheep in New South Wales alone; the tour of Mr. Crick, minister for lands through the arid districts of the western division, and the appointment of an interstate commission to inquire into the whole question."

The scene of desolation which met the eye, during the recent ministerial tour, was pitiful. Sheep, dying in hundreds, parched earth, with no sign of vegetation, and dry lakes and creeks. At one place a triumphal arch to welcome the commission was reared from the bones of the animals which had perished during the drouth. This desolate region is enclosed by a network of rivers from which sufficient water could be obtained to irrigate and render fertile the land that is now barren and it is to be hoped the commissioners, who are convinced by their recent tour, that the future success of western Australia depends on a proper scheme of conservation, will succeed in rousing the government to definite action.

Prof. Newell Speaks. The following pertinent remarks were made by F. H. Newell, chief hydrographer of the United States government, in an address delivered before the Commercial Club and the Real Estate Exchange of Denver, Colo.: "Looking into the future, one realizes that there must come a time when water must be apportioned with justice to all, and a century or more hence we will have it dis-

tributed, not upon priority rights, but upon technical rights. We cannot have a farmer getting more water than he is entitled to because his great-great-grandfather or somebody else happened to secure the water-rights two months ahead of somebody else. Water must ultimately be conserved in the most just manner for the general welfare of all citizens."

Prof. Newell is in active charge of the work outlined by the irrigation act and the members of the Commercial Club unanimously agreed to aid the work of the commission.

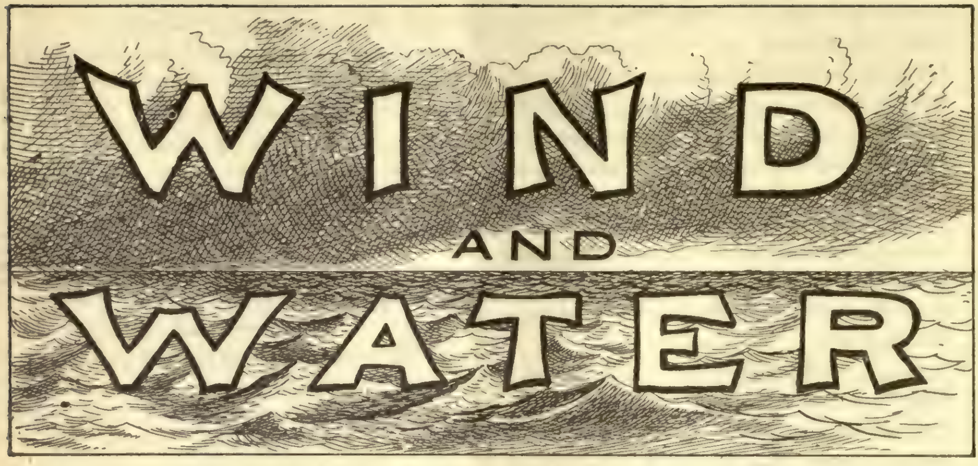
A Novel Scheme. The Southern Pacific railway is arranging to put in operation a novel colonization scheme. Passenger Traffic Manager E. A. McCormick says that 120,000 acres of land has been secured near Fresno, Cal. This land is to be cut up into small farms upon which will be placed all modern improvements before the property is offered for sale. Irrigation works will be put in operation on a large scale, creameries will be established, trees planted, and in many cases houses built, before any farms are sold. It is expected that a high class of farmers will be attracted, who desire farms already developed. The plan has novelty at all events.

Prof. Golf's Visit. Prof. Golf, the eminent German scientist of Bonn University, Germany, is making a tour of this country for the purpose of investigating the agricultural conditions, character of the soils and irrigation methods in use here. While in California he was greatly interested in the pump method of irrigation, which is profitably used in sections there. The contrast between the farms that were in need of water and those whose owners supplied the necessary moisture to their crops and orchards by means of pumping outfits, was altogether in favor of the latter. Truck farmers and orchardists were especially enthusiastic in praise of this method, claiming the increased yield in fruit and vegetables more than repaid the cost of running the gasoline or other engine used. Prof. Golf will take home with him samples of soil from various sections of this country as well as a very comprehensive idea of our farming methods, especially in relation to irrigation.

Raising Silk-Worms. Secretary Wilson has secured an appropriation of $10,000 from Congress for the purpose of making experiments in the raising of silk-worms and the production of raw silk. We are now importing about $45,-000,000 worth of raw silk annually, and Mr Wilson thinks that it is possible for us to raise a good deal of the supply in our own country, if the wives and daughters of the farmers and people who live in the villages will take up the industry.

Secretary Wilson thinks that silk raisin ought to be introduced into the South, because the climate is especially adapted for it and the colored women and children could earn a good deal of money that way.

The census has disclosed some very interesting and surprising information concerning the manufacture of silk in the United States, and shows that we are second to France only in the annual value of our silk production. Only a few years ago we were dependent entirely upon France and Italy, but during the last ten years every weave, every article and quality known to silk manufacturers has been produced in this country, as well and generally better than in Europe, and we now furnish practically everything except a few specialties and novelties in the way of fancy dress goods, velvets and ribbons, which still come from France.—*Chicago Record-Herald.*



PUMP IRRIGATION—ELECTRIC POWER FOR IRRIGATION IN CALIFORNIA.

Irrigating by electrically operated pumps has been for some years in a more or less experimental stage in California, and has been an interesting pastime for wealthy or particularly enterprising landholders. Now, with the great extension, during the last year or two, of the territory reached by the long distance electric transmission lines of the state, this mode of irrigating has gone beyond the experimental stage. It seems to be fully demonstrated that pumping by electric power is a cheap and satisfactory method. With the low rates for power which now obtain a relative small supply of water can, by almost constant pumping, be made to irrigate a fair-sized orchard, and to keep it in fine condition. With the rapid progress of electrical development has come an equal development in its use for irrigation. Already many of the older plants are out of date and are being replaced by the latest refinements in centrifugal pump practice.

Numerous old pumping plants have been taken out and especially designed apparatus of higher efficiency has been substituted with satisfactory results. Ideas on economic pumping are also changing with experience. Until recently there was a feeling among irrigators that there was not great economy in pumping against high heads for irrigation work. This idea has, however, been disproved by recent practice, and where formerly 15 or 20 feet was considered a high enough head, heads of from 70 to 100 feet are now qnite common.

Previous to the advent of cheap electric power the orchardists in

the orange belt of Tulare county had already made an extended use of pumping for irrigation purposes. The value of the land in that locality for orange growing, the dryness of the climate, and the impracticability of securing river or artesian water for irrigating purposes rendered pumping a necessity. More or less extensive steam, gasoline, and horse power pumping plants have therefore been quite common in the vicinity of Lindsay and Porterville for a number of years. As might be expected this locality has been one of the first to take up and make effective use of the electric current for irrigation.

This district is now covered by the lines of the Mt. Whitney Power Co. which has power houses within 30 miles of Visalia, Cal. This company recently increased its plant by the addition of 1800-horse power. This has now been largely absorbed for pumping purposes and an additional power plant will soon be installed.

The Krogh Manufacturing Co. of San Francisco, which has supplied many pumping plants for the orange groves of Tulare county, gives the following details of the irrigation work there. The water is found at a depth of from 50 to 75 feet. Wells 5 x 7 feet are usually excavated to within 20 feet of the water. Below this level there is usually a 10-inch bore. The motors and pumps are then placed at the bottom of the excavation and do not require a great amount of attention.

What is known as the Nob Hill plant was recently installed near Lindsay, Here a centrifugal pump driven by a 20 horse power motor elevates 500 gallons per minute against 95 foot head. This plant replaced a pump and motor which required 30-horse power for their operation. An orange grove in Tulare county is irrigated from this source.

Lowell C. Jones of Los Gatos irrigates an orchard at Lindsay by means of a centrifugal pump and 2-horse power motor. The pump raises 60 gallons of water per minute to a height of 60 feet, using two electral horse power. This plant replaced an 8-horse power centrifugal pump and shows much greater economy.

Peter Ting of Porterville is using a plant which has been arranged to pump 111 gallons per minute to a head of 50 feet. This plant gives an efficiency of 47 per cent with 3 horse power.

At Lindsay Heights a plant operated by a 50-horse power electric motor pumps 750 gallons of water per minute to a height of 150 feet.

IRRIGATION IN FIELD AND GARDEN.

By Professor E. J. Wickson.

(Reprinted from Farmers' Bulletin No. 138, issued by U. S. Dept. of Agriculture.)

The furrow system is the simplest, cheapest, and most widely used method of irrigating all field and garden crops which can be

Fig. 16.—Field irrigation by the small-furrow system.

grown to advantage in rows (Fig. 16). It is practicable on surfaces differing widely in slope and in soil characteristics. If the slope be not too sharp to carry a small stream without much cutting, the rows are run straight down the grade from the lateral or flume running along the crest or ridge of highest ground; if the descent be too rapid, the rows are run diagonally from the supply ditch at whatever angle gives the proper slope. The distance a stream in a furrow can be carried successfully depends upon the nature of the soil and the size of the stream. The coarser the soil the larger the stream or the shorter the distance.

With shallow-rooting plants, like those comprising most field and garden crops, a larger stream and a shorter run are used than in irrigating fruit trees, because it is desirable to have the water spread freely nearer the surface. For this reason, and to secure more even distribution over the field, a second lateral ditch or flume is taken across the slope at a distance of 40 rods or so from the first, and a lower length of furrows is fed from this secondary source.

The whole system, then, on a broad, gentle slope would consist in a supply ditch passing down the slope with laterals at right angles or on contour lines, from which the water is admitted to the furrows made with a small, double moldboard plow between the rows of plants. The lateral, whether it be ditch or flume, should be as nearly level as possible and kept well filled with water, so that the amounts dis-

charged at the openings shall be nearly equal. The openings are simply cuts in the side of the ditch, each one supplying several furrows, and divided with hoed or shoveled ways in the earth. If the flume is used, the water is taken out through holes bored at proper intervals in the sides, and if the slope along the line of the flume is too rapid, the lengths of the flume are leveled and "drops" arranged

FIG. 17.—Furrow irrigation on a slope with stepped flumes and drop.

for the water from one length to the next. Thus a series of flume lengths, each one level, may be carried down quite a slope by steps (Fig. 17), and give equal discharge of water for all the furrows of a wide field.

There are very many ways by which water may be brought to the heads of the furrows, such as movable troughs, canvas hose, etc., according to the local conditions and the ingenuity of the operator. If the soil is not too porous, the furrow method is a good recourse when a small stream of water running continuously has to be used; for it is easy to arrange so that attention need to be given to it only at intervals and the irrigator can proceed with his other work.

This furrow irrigation operates on a flat culture basis. As soon as the ground dries sufficiently a cultivator is used between the rows and the ground leveled and pulverized as thoroughly as possible to prevent surface evaporation and baking of the soil. When another irrigation is needed new furrows are made as before.

(To be continued.)

IRRIGATION IN AUSTRALIA.*

By J. L. Thompson, Traveling Agricultural Instructor.

VICTORIA.

Great enthusiasm was displayed in Victoria, about the year 1886, when an Irrigation Act was passed. A Royal Commission had previously visited America, owing to the persistent efforts of the late Mr. Hugh McColl, M L. A. for Mandurang, who preached irrigation for many years in and out of season. The Irrigation Act of 1886 empowered the government to borrow for irrigation works in Victoria £3,500,000. The first important feature of this act is that all waters of the colony, including rivers. creeks, lakes, etc., are declared to be the property of the state, and to be held and worked by the state, or by Trusts appointed by the state for the benefit of the people. Thus, what is known as "riparian rights" (the great stumbling block to irrigation in New South Wales) are entirely swept away forever. Provision was made for National Works and Trust Works.

National works means those works which, in the opinion of the Minister and Parliament, are of such magnitude that they should be constructed by and retained under the control of the state.

Trust works means work undertaken by a Trust appointed by the Minister controlling the Department of Water Supply. There are gigantic national works on the Goulburn river, in the shape of a substantial weir, with a channel on the east side of the river 31 miles long, and another on the west side 24 miles long, capable of conveying 20,000 and 100,000 cubic feet of water respectively per minute. Other works of a national character are being constructed at Kow Swamp, Campaspe, Broken River, Loddon River, and elsewhere. Over thirty Trusts have been formed. The Trusts have power to borrow money and control the water supply. Some splendid returns have been obtained, the results of irrigation. I have seen some fields of wheat under irrigation which yielded ten bags per acre, and where the crop was not irrigated only one bag was obtained. This was on the border near Swan Hill, and we have thousands of acres of the same kind of land in this colony. Mr. Leitch, Kerang, was among the first to demonstrate the value of irrigation for general farm crops. He produced six bags of wheat per acre on irrigated land in a very dry season, while on land not irrigated only two bags of a much inferior sample were harvested. He produced also 35 bushels of oats per acre, while on the unirrigated land the yield was nil. Mr. Leitch

* Being portion of a lecture delivered by Mr. Thompson at Tumut in February last.

also produced fine crops of lucerne, etc. The late Mr. Gardon of the same place obtained 30 bushels of wheat per acre, while the adjoining crops, *not irrigated*, were so bad that the stock were put in to consume them.

Mr. Patchell, also of Kerang, produced by means of irrigation the following results:

Wheat, from 20 to 45 bushels per acre.

Oats, from 40 to 70 bushels per acre.

Cape barley, 30 to 52 bushels per acre.

Mangolds, 40 tons per acre.

Onions, 20 tons per acre.

Potatoes, 9 tons per acre.

Flax, 2 ft. 6 in. lonfi.

Lucerne, cut eight times per year; also maize.

Sorghum and all kinds of fruits to great perfection and profit.

J. S. Angas, of Mincha West, produced six bags of oats per acre, while unirrigated land of the same quality only produced one bag per acre of a much inferior sample.

D. Milburn, of Grange Farm, Keilor, near Melbourne, sold in Melbourne £1,000 worth of fruit from 20 acres of land under irrigation.

Mr. O'Connell, of Bacchus Marsh, a much moister district than Kerang, produced, by means of irrigation, immense crops of wheat, barley, oats, chicory, beets, mangolds, potatoes, carrots, cabbages, etc. Lucerne was cut four times, and yielded four tons per acre of hay per annum.

Mr. Palmer, of Clyde Bank, fattened ten sheep per acre on irrigated land, but on land unirrigated he could only carry one sheep per acre.

Mr. Kavanagh, of Lake Erie, Mooroopna, irrigated 60 acres of lucerne in November. In fourteen days the lucerne was 14 inches high. He applied water to the paddock three times, giving it 3 inches all over each time, with the result that he fattened fifteen sheep per acre, and that at a time of the year when the country for miles around was dried up, and not a particle of grass for stock anywhere, except under irrigation.

MILDURA.

Gigantic efforts in irrigation were commenced at Mildura about the year 1886.

The Chaffey Bros. obtained certain concessions from the Victorian government, on condition that they fulfilled certain obligations in connection with the establishment of an irrigation colony. Everything went on well for a time, and a large number of highly respectable settlers from all parts of the world were attracted to this settlement.

They were mostly inexperienced in the art of irrigation and successful fruit-growing; and this, together with the failure of water-supply to the planted blocks at a critical period, caused general disappointment. The management was taken out of the hands of the Chaffey Bros., and the firm financially collapsed. The reasons of the failure may be briefly stated as—(1) Want of capital; (2) errors in laying out the settlement—want of compactness; (3) indiscriminate sale of land; (4) seepage from main channel; (5) bad stocks, insufficient water supply, and defective means of communication, and the want of experience as far as the settlers themselves were concerned.

The collapse of Chaffey Bros., however, does not imply the failure altogether of Mildura as as irrigation settlement. Although the greater portion of the planted land cannot, as yet, be said to be in full bearing, some of the settlers have made substantial profits during the last two or three years; as much as £430 has been realized from a ten-acre block.

The quality of the raisins, dried apricots, canned peaches, and other fruits cannot be excelled. The olive also flourishes at Mildura, and excellent oil is now being made. The fig also grows remarkably well, and the prospects of some of the settlers are very good.

NEW SOUTH WALES.

Irrigation in this colony has never been put on a proper basis. A bill was prepared by Mr. Lyne in 1892, entitled "The Water Conservation Bill," but was not passed by Parliament. This bill dealt with the definition of water-rights, national administration, local trusts, drainage works, navigation, etc.

Before irrigation can be successfully adopted, a bill, similar to this, must be passed by the Legislature. In many parts of New South Wales irrigation is carried out with great success. Mr. H. G. McKinney, chief engineer for water conservation, has stated, "There was certainly abundant evidence that the pastoralists were not wanting in enterprise in providing water for irrigation."

During the years 1889, 1890 and 1891 prizes were awarded by the government for the best irrigated farms and orchards. The competitors west of the Dividing Range represented properties on the Namoi, Lachlan and Murrumbidgee Rivers; those east of the Dividing Range represented the Hawkesbury, the Parramatta, and the Bega districts. The properties which were entered showed in a number of instances a highly creditable class of work, and showed also that irrigators had the ability and judgment to select the methods best adapted to their circumstances.

The municipal councils of Wentworth, Hay and Balranald have been constituted an Irrigation Trust by a special act of Parliament,

and it is anticipated that highly successful operations will soon be carried out.

The value of irrigation to the pastoralists of New South Wales cannot be over estimated; the risks of pastoralists from drouths is very great. Land in the Lower Darling, in its natural state, can scarcely support one sheep to ten acres; but is capable of supporting more than twenty sheep to one acre when laid down in lucerne and irrigated. The capabilities of irrigation in New South Wales are simply immense. The great rivers of the western watershed of the great Dividing Range are the Darling, Lachlan, Murray and Murrumbidgee; the Tumut, a tributary of the Murrumbidgee, 80 miles long; Namoi, 600 miles; Bogan, 450 miles; Gwydir, 445 miles; Barwon, 510 miles; Castlereagh, 365 miles; McIntyre, 350 miles; Macquarie, 750 miles; Warrego, 100 miles; all tributaries of the Darling which flows into the Murray, 300 miles below Albury. The Murray, with the branches mentioned, drains fully 500,000 square miles. It must be ranked with the large rivers of the world, and will, in the future, exercise a most important influence on the destiny of the colony. In itself, it is 1,120 miles long, and navigable over 1,000 miles in ordinary seasons. The Murrumbidgee is navigable for 700 miles; the Darling, 1,700 miles.

It has been estimated by an enthusiast in irrigation that if one mile on each side of the great river Darling were cultivated, and sown with lucerne under irrigation, it would produce as much fodder as would save the lives of the large number of sheep that we lose every period of drought.

Mr. Gatenby, at Jemalong, on the Lachlan, has demonstrated the value of irrigation in growing large crops of lucerne, and storing it away in silow and stacks, enabling him not only to save the lives of his sheep, but actually fatten them at a time when there was no vegetation about.—*From Agricultural Gazette of New South Wales, August, 1899.*

SOIL SAVING—SIMPLE METHODS OF PRESERVING THE FERTILITY OF AGRICULTURAL LANDS.

BY LEWIS C. BURNETT.

EDITOR IRRIGATION AGE, CHICAGO, ILL.:

Dear Sir: I take the liberty of handing you copy of an article written by Lewis C. Burnett, of Otoe county, Nebraska, a practical and successful farmer, with an experience covering more than a quarter of a century in the state of Nebraska.

This article, as you will note, relates to soil saving by the simplest and commonest methods, and yet the results as realized by Mr. Burnett and set forth in the article are so remarkable that it is a wonder more work of this kind has not been done. My only object in sending you this is to promote the agricultural interests of our state, and you are at liberty to use part or all of Mr. Burnett's article.

In justice to Mr. Burnett I would say that he prepared the article for the local home paper, and after hearing it read I prevailed upon him to let me have it copied and sent to some of our leading journals for publication. It has not been published in any paper or periodical up to this time. Very respectfully yours,

A. G. WOLFENBARGER,
President Nebraska Irrigation Association.

The founder of the *Orange Judd Farmer* once said: "If the eastern farms could have a few inches of Nebraska soil the farmers there would be rich." Yet we are giving the Missouri river, such years as this, enough soil to make an eastern state rich for a century.

I claim that the loss in soil to Kansas and Nebraska this year far exceeds the loss by drouth last year.

One man asked me, "What if you do lose some or all of the black soil, there is plenty more soil to plow." Our subsoil is rich and with plenty of manure and good cultivation can be made to produce good crops eventually. But he did not know it has taken ages to prepare the black soil for man's use and the surface soil is to the earth what cream is to the milk; if the cream is taken off you have skim milk, or "blue John," and it will make more than one John blue, who has to cultivate poor washed soil. Always remember that good soil responds nobly to every effort spent upon it. It will stand more drouth, more rain, more heat and cold, and will not require near the work upon it to produce a good crop as the poor soil will require to produce a poor crop. Poor soil has no mercy on a lazy man.

There has not been a heavy rain during the past fourteen years during daylight hours, when I have been at home, that I have not put on my rubber coat and boots and gone out and worked to save my

soil or watch the effect of the rainfall upon my farm. My better-half often scolds me for so doing, but I just cannot help it. As a good Quaker would say, "The spirit moves me too hard to keep still," but having been born "on the banks of the Wabash—far away"—may have something to do with it. In my last conversation with the late lamented J. Sterling Morton, we were talkiug exactly along this line, and in his last speech in Chicago he embodied some of these ideas. Our esteemed friend, J. C. Bowlby, of Crete, has also written good words as to the creation of artificial reservoirs to hold back much of the surplus water till the time it is needed.

This was my idea when I first began to dam up the draws on my place fourteen years ago, but I had no idea of the results that have taken place in the saving of soil. The first pond I made was 10 feet deep, 250 feet long by an average width of 50 feet. Now this is full and the soil much higher than the original level of the water; about 12 feet of fill in the two ponds and the draw leading into them. I have caught what would amount to one foot of soil from four acres of ground, and in the two reservoirs on the north side of my place, made during the past two years, I have caught half as much more soil, so in round numbers I have caught from my neighbors' farms one foot of soil one rod wide and six miles long, or one foot of soil (it's cream if you please) over six acres of ground, and this from only seventy acres. Now this is the result of only a few short years.

Wake up, Mr. Farmer of eastern Nebraska, you are giving to the mighty Missouri river the wealth of an empire, and all the money of the Standard Oil Company could not replace what Nebraska and Kansas have lost this year.

The loss will not be in diminished crops this year so much, but the soil will never be as good as it was and the drouth of coming years will hurt us far more. What I have said and will say applies more to our hilly and rolling farms and it is these that I have been watching.

Some have said to me, "I cannot afford to build so many dams; they cost too much and are liable to wash out the first big rain." Wrong again; a dam made as I will explain it will stand an immense amount of washing and pressure before giving way and only a little care and watching will preserve it against any freshet. In the making of a dam, if a large one, clean off the black soil till you are down to the clay subsoil. Then clean off the black soil from where you are to get the dirt to make the dam, of course from the pond side of proposed dam. Utilize this dirt at the back side or ends of the dam. Now you are ready for business. You have a clean foundation, say 50 feet wide and 100 feet long, Begin and lay a layer six inches deep over the whole bottom at once and so continue until completed. A

dam from 10 to 12 feet high should be at least 50 feet wide at the bottom, with a long slope both ways. A fatal mistake is often made in making the dam too steep. When properly made the constant tramping of the horses, especially if the soil is moist, will so toughen the soil that it will resist washing of the water more than most people will believe. I have one dam over which the water has run for years, whenever it rains very hard, yet have not lost as much soil as I can put back in one day. Now, mind you, this can be done on the farm when no other work can be done, on days when it is too wet to work at anything else. Have a scraper of your own, go and do a half or a day's work as you can now and then, and soon you will be surprised at what is accomplished.

If every farmer could hold back as much water on his place as I do we would have in our county (Oteo, Nebraska), alone 10,368 acres surface of water, and as soon as they filled with soil wash there would be 10,386 acres of the finest meadow soil in the world, worth at least \$50 per acre. Then we have brought into actual worth \$519,400 in our county alone, and that, too, from the waste places, and there are thousands upon thousands of such places throughout our land.

We heard the other day that our county had lost \$50,000 worth of bridges by recent rains. Now, if this flood of water had been partially held back, much of this heavy loss might have been prevented.

We are told that the Mississippi river is carrying into the Gulf of Mexico a body of dirt equal to a block of earth six feet in diameter moving at the rate of four miles per hour, year in and year out, night and day, or in other words, depositing in the gulf 12 acres of surface soil per hour, or 288 acres every twenty-four hours; again we can say, the cream of our broad acres! When I started out on this line of thought I had no idea where it would lead; the subject is startling. Our government and the states bordering on the Mississippi river are spending millions upon millions to get rid of what is such a loss to us. We are asking the government to spend more millions to build big reservoirs and dams in the west to conserve the surplus water till the day of need. By far better let the millions of farmers create on their own little farms, ponds, lakelets and pools, and far greater results will accrue to the fairest of Uncle Sam's domain—Nebraska, Iowa, Kansas and Missouri.

Mr. Clayton, living near the mouth of Camp Creek on the Peru bottoms, twelve miles below Nebraska City, has caught soil-wash to a great extent. This year alone he has caught eighteen inches on an eighty acre piece, and has this year two hundred acres of corn above high water mark, where a few years ago there was a slough or low bottom land. On this piece of land there is a fill of about eight feet. If you please, how many hill farms has this impoverished? This

ought not to be, and can be prevented, and must be or our fairest acres will soon cease to produce more than twenty-five bushels of corn to the acre and the drouth years will become more severe.

One of my neighbors built a dam on his farm that backed water three hundred yards and at the deepest was eight feet deep. Will you believe me, just one rain filled this to the top with dirt that came down with the rush of water from the corn fields, over which as soon as it was settled he hauled the largest loads of hay, and he said to me the other day, "If I had not sold my farm, I would put in at least one month's work building dams this summer and fall." Again I say, wake up, my friends, farmers, you can ill afford this fearful loss, at least when you can easily prevent it yourselves by spare hours of work now and then; and this grand work has in it more to our fair country and state than all the gold of Alaska.

And the creation of these little reservoirs is replete with great results now and hereafter. It will replace the thousands of natural pools that we have so ruthlessly and thoughtlessly destroyed. Springs will again break forth from their hidden sources and instead of a mighty rush of water after every big rain, we will have a steady flow of spring water down our creeks and branches the year round, in which the finny tribe will sport and hide as they did twenty-five years and more ago. Do you think I am wrong in this? Ask the early settlers of Eastern Nebraska so short a time ago as the years are counted only half of a good life time. Illinois has ditched and tiled her farms and emptied her sloughs and ponds till the question of moisture is almost as serious there as here.

Dr. Johnson, a writer of prominence of Champaign county, Illinois, has said: "Yes, we have tiled and ditched our farms to get a few more acres, and to abolish chills and fever; but we have instead introduced typhoid and kindred diseases that kill far more than fever and ague ever did." As I stood on the banks of the Wabash last year and looked at its low water, I could not help regretting the day when good sized steamboats loaded and unloaded at the wharves at Terre Haute.

I have traveled eight times in a wagon the full length of our state, besides the thousands of miles I have made in other journeys through most every state and territory in the West. I must say we have the best of Uncle Sam's domain and let us take good care of it and it will continue to pour into our laps more golden dollars than all of the mines of the mountains.

Bayard Taylor, the great traveler and writer once said: "I have traveled all over the Globe but this Missouri Valley is the best of all." Was he not right?

If what I have written will move some of our farmers to put into

practice what has been urged herein, others will see the great advantage of so doing and the good work will go on.

Tree planting is one of the grandest works given for man to do in partnership with nature. Oh, how I love it!

Campbell's soil culture is good; but the saving of soil and moisture too is good, and these three together, and together they should go, will do more for this country than anything else. We can then rest assured the drouth and stormy years will lose half their terrors.

Nebraska City, Neb., July, 1902.

"KNEE DEEP."

They are calling "Knee deep!" Knee deep!" tonight in the marsh below,
Down by the bank, where tho rank bulrushes and calamus grow,
Hark! how the anvils ring, as the silver hammers smite,
To the chime of that old rhyme, all the golden summer night,
Over the swampy forgc the sparks of the fireflies rise:
In the shadows the maiden lilies lean with languorous sighs
To their lover, the whip-poor-will, who is watched by the fluffy owl,
While the night-hawk shuffles by, a monk in a velvet cowl,
And the bat weaves inky weft, through the white star-beams that peep
Down through the cypress boughs, where the frogs all sing "Knee deep."

Sometimes a song will beckon a heart-broken man like me
Back to the bygone years, and the scenes that used to be
When this world was fenced from heaven by one rose hedge, and through
That bourne the blessed angels looked, and asphodal odors blew,
So, listening to the lilt of the minstrels among the reeds,
My soul leaps out of its human husk into the elover meads;
And I see the storm king ride the summer clouds in state,
With chariot whip of livid flame and thunder billingsgate;
And watch the tawny tide, 'mid the lush sword grasses creep,
While the frightened frogs all cling to the willows and sing, "Knee deep.

Knee deep I wade in the rippled creek, with buttercup bloom o'erblown,
Heaving like gold on beauty's breast, its sheen half hid, have shown;
Knee deep in the saffron marigolds that prank the meadows fair,
Like a school of Saxon children, blue-eyed and with yellow hair;
Knee deep in the whortleberries on the upland slope I stand,
With torn straw hat half full, and a quail's nest in my hand;
Knee deep in amethyst autumn leaves I rustle toward the place
Where tho pert and upright rabbit sits and washes her innocent face.
Song of the quivering culms and osiers! I am wading again, in truth,
Knee deep in the stream of memory that flows from the land of youth.

—Bobert McIntyre in the Colorado Magazine.

WORK OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

A communication from Elwood Meade during his recent visit here.

The work of the United States Department of Agriculture on irrigation is primarily agricultural. It has to do with the quantity of water used by farmers, the methods of use, and the results obtained. Two comprehensive reports covering these phases of the work have been published and a third is now in press, and will be ready for distribution early in the coming fall. These reports contain the results of measurements made in each of the arid states, and in several of the states where irrigation is ordinarily considered unnecessary, including Missouri, Wisconsin and New Jersey. The work in these latter states, while of much less importance than in the states where irrigation is necessary, has attracted considerable attention because of the profits shown to come from the use of water during periods of drouth. In some of the arid states the extension of the irrigated area depends very largely upon a better and more economical use of their water supply, since nearly the entire supply is used under present conditions. The work of the irrigation investigations is to point out the way to this better use.

It has been found that the success of irrigated agriculture depends very largely upon the laws and customs which have to do with the use of water. The Department of Agriculture has therefore taken up these subjects. An exhaustive report upon the legal and economic situation in California has been published, and a like study has been made in Utah, the results of which will soon be ready for distribution. The annual reports before referred to contain much along these lines also. In these reports Mr. D. W. Ross, state engineer of Idaho, calls attention to the economy in the use of water, which is being brought about by a modification of water right contracts. Mr. Ross has given considerable attention to this reform and, owing to his efforts and those of others connected with this investigation, canal companies are substituting contracts under which the water is measured to the farmer and he pays only for what he uses, in place of the earlier contracts where he was charged a flat rate for the area irrigated, regardless of the quantity used. In this way the farmer is led to economize because he gets the benefit of his savings.

Changes of this kind have increased the need of more accurate methods of measuring water, hence the designing of cheap, efficient

water registers has been given much attention by this branch of the department, and a number of new patterns have been invented and are now being furnished to irrigators, by some of the leading instrument makers of the country, at very reasonable prices.

Congress at its last session increased the appropriation for this work from $50,000 to $65,000, and provided for the extension of the work along three lines: Investigations of the rights of riparian proprietors, the removal of seepage and surplus waters by drainage, and the use of different kinds of power for irrigation and other agricultural purposes. These subjects have only incidentally been included in the previous work of the office.

Some of the arid states early abrogated the common law of riparian rights, while in others the law is as definitely established. In others it is not yet settled by the legislature or the courts just what is the status of the rights to water. While opinions may differ as to what rights should attach to riparian lands, there can be no difference as to the fact that it should be definitely settled just what those rights are and just what lands are riparian. If all riparian lands have a right to a reasonable use of water for irrigation, and that right can be enforced against those using water on non-riparian lands, the owners of such lands, whether they will or not, act as a menace to the use of water by others. Non-riparian lands may be much more valuable, but the owners will not reclaim them, knowing that at any time their whole investment may be rendered worthless by the use of a previously dormant riparian right. If it is well known that these rights exist no individual injustice is done—the only harm may be in preventing development. But if it is uncertain whether riparian rights exist, large investments, made in good faith and with every reason for success, may be robbed of their value. The work of the irrigation investigations of the Office of Experiment Stations is to gather such data as may furnish a rational basis for legislation and court decisions on questions relating to this important matter.

Along most streams the lands first reclaimed by irrigation have been the low lands. This is due to the ease with which water can be brought to such lands. As settlement has advanced the higher lands farther back from the stream have been watered, with the result that much of the low land formerly cultivated has been made unfit for use by the drainage and seepage from higher lands. In other sections large areas of land having little slope have been ruined by the rise of the ground water, due to the filling of the subsoil by irrigation. In both cases the condition of the land has often been aggravated by the accumulation of alkali near the surface. This alkaline condition of the soil is uniformly attributed to poor drainage and excessive use of water in irrigation. The work of the irrigation investigations along

this line will be to study the engineering and legal problems connected with the drainage of irrigated regions. As a beginning of work in this line plans will be made for a drainage system adapted to the requirements of the region in the vicinity of Fresno, Cal., where the ground water has in some places come so near the surface as to kill valuable vineyards and where it threatens the life of the horticultural plantations covering still larger areas. Work along this line is also being being carried on in Colorado by C. G. Elliott, former editor of the *Drainage Journal*, and one of the foremost drainage engineers of this country. The work will be extended to other regions as time and funds permit.

The series of dry years through which California has recently passed, led to the development of the underground sources of water where it was formerly believed that the only available supply was the surface flow of streams. Many of the wells which at first flowed freely have since had to be pumped, and in many places a pumped supply has proved to be cheaper than the old supply from streams, besides being far more reliable. The experience of California in this respect has led to the establishment of pumping plants in other parts of the arid region, and to hope that a water supply may eventually be provided for vast areas of the Great Plains, which have been considered as beyond the reach of a water supply from any source. The recent developments of the rice industry in Louisiana and Texas, where the water from the rivers has been raised by pumps and spread over the high level prairies, have also added to the interest which is being taken in pumping water for the irrigation of lands which are beyond the reach of water taken from streams by gravity. In most localities the availability of a water supply by pumping is almost wholly a question of expense for power to run the pumps. The expense which it is profitable to incur for this purpose is limited to the value of the crops which can be produced by the water made available, and in many places the cost of power and the smallness of the crop which can be grown will prevent the use of pumps. It is believed, however, that considerable areas can be reclaimed by pumping. The long distance transmission of electrical power which has only recently been in use has made it possible to use the mountain streams to generate power for pumping water for use on lands which are beyond the reach of any stream, and still to use the water of the stream to irrigate its own valley. There are still great undeveloped water powers in the arid region. Steam power, generated by coal, wood and oil has also a great future, and windmills are capable of a much greater use than is made of them at present. There are some places where pumping can be made to serve the double purpose of irrigation and drainage, removing the water from the lands which it is ruining,

and bringing it to lands which are valueless without it. In such places greater expense can be incurred than where only one end can be served.

More briefly, the office will, as far as its resources permit, enter upon the study of different kinds of power for various agricultural purposes. There is as yet little published information on this subject and no systematic investigation of the many problems involved therein has been made. The collection and publishing of data regarding the efficiency of different kinds of pumps, engines and fuels, and the opportunities for the development and transmission of power for use in various kinds of agricultural operations will be a first step in this enterprise. Very little attention has yet been paid in this country to investigations along many of the lines of agricultural engineering. It is therefore very encouraging to have Congress show a disposition to broaden the work of the Department of Agriculture in this important direction.

HOW TO SAVE.

Some sage one has discovered, and has told in verses neat,
What a lot of cash 'twould save us if we didn't have to eat.

Let me add unto this wisdom, though the thought may make you creep,
We could hoard up gold in bedclothes if we didn't have to sleep.

Furthermore, 'tis borne upon me, with a force I cannot balk,
That we'd save a lot of leather if we didn't have to walk.

So, of all the bills that vex us, just the biggest one, I guess,
Would be spared for safe investment if we didn't have to dress.

Come to think the whole thing over, free concurrence you will give,
That vast wealth would line our pockets if we didn't have to live.

—*Chicago Journal.*

SUB-IRRIGATION.

When we see the word irrigation we are quite inclined to couple it with a running stream of water through ditches and onto the land where crops are growing, or are to be grown, because it has been so conceded by the masses for generations. History goes back to the very early days and conveys the same idea. But this is not the broad or more modern view; some rather phenomenal results have been obtained in recent years by sub-irrigation by the use of pipes and other means. Several patents have been taken out covering various devices and ideas, one of which we saw in practical operation; while not only being somewhat novel, its operation illustrated and demonstrated some very important points. In this case the idea was floral designs on the lawn.

A pipe was cut and bent to form the word HOME in large letters, and buried beneath the surface about 18 inches; the portion of the pipe forming the letters being perforated and the pipe generally kept full of water under very low pressure. The lawn was then nicely fitted and a fine lawn mixture of grass sown. This lawn had been seeded two years, and when we saw it there had been about three weeks of severe drouth; the main part of the lawn was of short and light colored grass, while directly over these pipes the grass was growing rank with a very dark green color in the center gradually shaded down to the light color. The word home stood out very prominently presenting a very attractive contrast. A similar condition, although the result of nature's own way, and might be properly termed natural irrigation, is shown in fields of small grain where from some obstruction the snow has drifted deeply across out into a field. When the warm spring days came the snow melted and percolated on down deeply into the soil below, as far as the free water could be carried by gravity. Springtime came, the wheat, oats or barley sown, soon the hot weather of early summer would begin to fade the foliage of the plants in the field, as the ground was getting dry; but lo, where the snow drift had been the foliage continued unusually dark green and the plants grew rank, indicating an enormous yield of grain, while all the rest of the field indicated a very short crop, if not a total failure.

These two illustrations demonstrate clearly that if there is plenty of moisture in the soil just below, it will come up and supply the demands of the growing plant, and in spite of the hot, dry weather (so disastrous to the plant where there is no stored moisture below) the plant grows and matures a fine crop. Hon. J. A. Morland, of McCook, Neb., in 1898 also demonstrated the same point by turning the ditches

loose onto his fields in July as soon as he had harvested his winter wheat and removed the crop. The water was allowed to soak down deeply. The field being quite level it soon dried off on top after the water was shut off. The field was quickly plowed and thoroughly worked down by thorough harrowing and again sowed to fall wheat; 1899 was a very dry spring, no rain of any account until June 7th. Nearly all winter wheat was a total failure. This field, however, made 41 bushels per acre grown practically by the water that was stored in this soil during the previous July and August; nothing more or less than sub-irrigation. These lessons should certainly be a pointer to those who can get water from these ditches in fall and spring, but usually find themselves short in midsummer. This would certainly apply to such soils as are found in the San Louis valley. When water is plenty, store it in the soil below where it may be drawn upon in time when water is short in the ditches. All there is required to successfully carry this out is to keep the surface soil loose and fine, forming a soil mulch which will prevent the loss of this moisture by evaporation.

Sub-irrigation of crops can be very successfully practiced in the semi-arid belt without the irrigating ditch, although not so conceded by most who considered themselves posted. To the masses who have spent much time on these semi-arid prairies the idea of raising crops generally without the aid of the great national reservoir and the irrigating ditch seems ridiculous, but notwithstanding this fact it can be done, and to some extent is now being done, and when the principles involved are generally understood and put to practice, there will not only be successful farming on much of these great prairies now largely given over to stock raising, but in Arizona and many of the arid sections the present supply of water will be found ample to successfully raise crops on fully two if not three times as much land as is now being covered.

In the more arid portions of the semi-arid prairies it will be necessary to crop the land generally only every other year, giving over each alternate year to summer-culture and the storage of the rain waters, the process of which is very simple. Careful investigation and observation demonstrates very clearly, not only from practical field work but by laboratory experiments, that from two and one-quarter to three inches of water are required by the different plants to grow and mature one ton of dry matter. Four tons of dry matter is a very good crop of any kind, thus indicating that from nine to twelve inches of water are necessary to grow a good crop of corn or wheat. Now the fifteen inch annual rainfall goes well into Eastern Colorado centrally on the Eastern line, therefore, if one year is given over to the storage of the rain waters the combined rainfall of two years will

be thirty inches or nearly three times as much water as is needed for a good crop. While this manner of reasoning may seem a little crude to some, yet practical experiments and results prove conclusively that it can be easily accomplished and with little if any more expense than is necessary to attend the lateral ditches in irrigating a field.

Mr. William McCollum, of St. Francis, Kan., twelve miles east of Colorado, set out an orchard of some two hundred trees in the spring of 1895 and began a system of careful cultivation to conserve the rain fall in the soil. This work was carefully continued through 1895, 1896 and 1897. In August, 1897, a boring test was made to ascertain how deep the moisture had gone down. The discovery that it was so moist for sixteen feet and two inches down that a ball could be made of the soil at any point was quite a surprise, while just across the road no perceptable moisture could be found below eight inches, the result of a recent good rain. Another illustration which substantiates the fact that water can be stored and utilized the following year, is the result of the wheat crop on the Pomeroy model farm at Hill City in Western Kansas this season. The particular field referred to had corn on in 1900. During 1901 it was carefully cultivated to store and conserve all the rain waters possible and seeded to wheat that fall. On May 9, 1902, Prof. D. H. Otis, of the Kansas Agricultural College, visited this field. This date was just at the close of the severe early drouth that so seriously damaged the Kansas wheat crop. In Prof. Otis' report of his findings he says that on the upland the wheat by the ordinary methods looked poorly, was only five to six inches high, and very thin. Comparing these fields with those on the Pomeroy farm, the contrast was marvelous. He further states that the farmers, merchants and professional men all agree that the Pomeroy model farm is naturally the poorest in the neighborhood, that for ten years before the establishment of the Campbell system the land had been farmed by various parties but no one was able to raise a paying crop. The first wheat field visited on the Pomeroy farm was on some of the highest land in the county. Here we found wheat twenty to twenty-two inches high, apparently too thick, of a very dark green healthy color from the ground up. Actual count showed from eighty to one hundred stalks in one foot of a single drill row. On top of this was the remarkable fact that only twelve quarts of seed was sown to the acre, while on the average field from thirty-two to forty quarts had been sown. Upon boring for moisture over two feet of moist soil was found below this field, while adjoining fields were apparently dry.

It is proper to add that just before Prof. Otis' visit the first rain of any value came, after which rains were ample. This field made forty-six bushels to the acre, while other fields on the divide yielded

from eight to fifteen bushels. Here is certainly recorded a positive demonstration, not only that moisture can be stored in the soil below, but that when put there it will carry the plants in perfect condition over prolonged and severe drouths.

We are also reliably informed that a field of 60 acres of corn is now growing 40 miles east of Denver on the Kansas Pacific line, and it is claimed by those that have seen it that it will make fully 40 bushels of corn per acre. This too is the result of this same process of storing and conserving the natural rainfall and then continued careful cnltivation to prevent the loss of the stored moisture by evaporation. The same principles involved in the Campbell method of raising crops on the prairies of the semi arid belt applies very largely to the raising of similar crops by irrigation.

Campbell's 1902 Soil Culture Manual, containing over 100 pages, covering every detail very clearly, with several illustrations of the soil in its various conditions, showing how water moves in the soil, will be mailed to any address on recipt of 40 cents. One hundred and fifty of these books are in use by the Kansas Agricultural College as text books in the classes in crop production. Address

H. W. CAMPBELL, Holdrege, Neb.

A JUMPER.

He jumped out of bed and he jumped into his shoes,
He jumped for the paper that had the day's news;
When breakfast was o'er he jumped, quick as a cat,
For his big outside coat and his everyday hat.

He jumped on the car that was going down-town,
And he jumped to shake hands with his neighbor, Miss Brown;
He jumped from the car when the office was reached,
And he jumped with alarm when the fire whistle screeched.

He jumped into harness to do his day's work,
And never was known one small duty to shirk.
When doing his work, if folks into him bumped,
He stopped not to argue, but over them jumped.

He jumped at each chance that the day brought to him,
To enlarge and expand his wallet's bright rim.
And when he got through at the end of the day,
He jumped on the car that was going his way.

His wife and his children jumped at his return,
To greet him, and all the day's triumphs to learn;
And when the last prayer and good night had been said
Year in and year out he jumped into bed.

—*Albang Evening Journal.*

AGRICULTURE.

ALFALFA A NEBRASKA MONEY MAKER.

Alfalfa raising is rapidly becoming an important industry in parts of Nebraska, where crops less dependent upon frequent rainfall are uncertain. Introduction of this crop in these regions is revolutionizing farming. Scientific farmers have long advocated the growth of alfalfa, recognizing its value as a stock food, but it is only within the past few years that it has been grown extensively east of the Rockies.

We are indebted to J. F. Crocker, a member of the executive committee of the Business Men's Association of Kearney, Neb., for a copy of a booklet issued by that association. The brochure is devoted to an exposition of the value of alfalfa, celery and sugar beet crops in Buffalo county, of which Kearney is the county seat. "The main point we wish to impress upon the mind of the reader," says the book by way of introduction, "is that each of these crops is successfully grown in this locality without irrigation, a condition not considered possible in commercial quantities a few years ago." The alfalfa acreage of Buffalo county is estimated at [illegible],000 acres, which will be increased by [illegible],000 or 15,000 acres in 1903.

The value of alfalfa as a stock food is well known. For the semi-arid regions it is an invaluable crop. Roots of the plant bore deep for water. A three-year-old plant often has roots measuring eight feet long. It is perennial, and fields are in good condition after twenty-five years of constant cropping. As from three to four crops may be cut each year in fields from three to four years old, averaging from three to five tons an acre, its value is better realized. As to the value of the product, the [illegible] says:

"Actual results from experimental stations of several states are that four tons of alfalfa are worth $8 a ton to feed four-year-old steers, or per acre $32; four tons are worth $10.50 a ton to feed two-year-old steers, or per acre $42; four tons are worth $16 an acre to feed yearlings, or per acre $64; four tons are worth $20.60 a ton to feed hogs and lambs, or per acre $82.40." It is stated that Buffalo county has 175,000 acres of valley land that will average four tons to the acre.

Kearney celery is well known in the produce world. There was a struggle to market it at first, because produce dealers feared it would drive out Michigan celery. But it is now freely sold for ten to fifteen cents a dozen more than Michigan celery. The Platte river islands are especially adaptable to growth of celery, of which 775,000 pounds were shipped by express alone in 1901. "Five acres of celery successfully grown and rightly handled will make more money than the average quarter section of land in corn," it is stated.

Sugar beets are a success there, bringing $4 a ton. The average yield an acre is from ten to sixteen tons, while the cost of production varies from $25 to $30 an acre, depending on the distance for delivery of the crop.

The booklet is of interest to all who are interested in the development of the middle West. It is put up in neat folder form, well printed, and is a credit to the business men of the town that is "out for business" in every sense of the word.—*Apparel Gazette.*

FRUIT GROWERS COMBINE.

In these days of Trusts and Combines in other interests many of the fruit growers in the districts devoted largely to the growing of the fruit, have endeavored by combination, to purchase supplies more cheaply and secure quicker and better transportation facilities and to market their products to better advantage.

Perhaps a recent study made in dis-

tricts where combination failed and in another district where they were successful, with the reasons of failure and success may be interesting.

At Predonia, in Chautauqua County, New York, the production of grapes for the table use had reached such large proportions that in the absence of appropriate concerted efforts to market to the best advantage, returns were sometimes so very low as to be discouraging and often unprofitable. In the absence of concerted action so many car loads might be shipped to one market as to depress and break the price in that particular market when in other towns and cities there would often times be a lack of full supply. This led to the formation of a shipping association which should, through its superintendent, keep in telegraphic communication with the leading markets of the country and aim to place each car where there was the most room and the price for it. This combination was able to secure most favorable terms in purchasing supplies; that is, baskets and fertilizers, for its members. It was able to distribute its product wisely in distant markets and avoid overcrowding any particular market. So far the association equalled the expectation of its promoters but serious trouble crept in. The association, however, failed to guard against one serious difficulty, a hardship common to all unions. In a labor union the quickest, strongest and best workmen carry the less skillful and less efficient workmen; so in this crop growers' union the growers who had soil best suited to vineyard work, who were careful cultivators, who properly fertilized the soil, had their product picked and packed with skill and care. found their superior product selling through the association at the same price as fruit grown on inferior land with less careful culture and less care in grading and packing. While the association maintained a corps of inspectors who should examine and check in fruit as delivered, it is not practicable in handling many car loads of fruit daily to inspect with such exactitude as to determine the absolute value of each grower's product. The fruit was sold in car lots at a stated price per basket. This method, while beneficial to the less careful grower, proved to be detrimental in some respects to those who had the best soil, gave the most careful culture and packed the best product. In a brief time the strongest and best growers in the association found themselves selling their product at a disadvantage.

A jobber receiving a car load of grapes and rapidly distributing them to his customers cannot safely pay more for any portion of the car handled as a car load than the undergrades of fruit within the car, since he can not stop to examine and closely inspect the quality of fruit in each basket. The jobbers in other towns quickly learned not to pay the jobber more per basket than the value of the less carefully grown fruit in the car. Jobbers desiring car loads of superior fruits began to offer one-half to one cent more to such large growers as could furnish a car load of the very best grade. This speedily detached from the association the best growers, resulting in crippling the association. The immense output of grapes from Chautauqua County, is now so widely known that buyers flock to shipping points and bid for the product, paying the better growers an agreed price car by car on track.

E. F. STEPHENS, Crete, Neb.

PROFITS IN TURNIPS.

Turnips are valuable farm and market roots that may be grown as a second or fall crop. The wheat stubble field often makes an ideal spot for growing these tubers. Some farmers claim to have produced 800 bushels to the acre. This is a pretty large yield, but there is no reason why half that crop might not be grown on

good soil, in almost any state. They are fine for feeding stock. Many families use them the same as potatoes for winter and and spring cooking. There is always a market for them at fair prices. It costs but little effort to plow and prepare the land and sow the seed. If cultivated, the labor is not so great as in many less profitable crops.

A mellow loam is the most desirable soil for turnips. Large crops are grown on new land, and on any well worked spot where other roots flourish. They must be grown quickly to prevent woody and hollow ones. The soil should therefore be placed in the best condition, and the season be favorable for sprouting the seed and starting the young plants. An abundance of nitrogenous fertilizers is necessary to insure good crops of fine specimens. For this purpose an application of cow or sheep manure is advisable. Where commercial fertilizers are used and available there should be about 600 to 800 pounds of a fertilizer having nitrogen 2 per cent, potash 5 per cent, and phosphoric acid 7 per cent, put on an acre and well worked into the soil. A good mixture for turnips would be about 400 pounds acid phosphate, 200 pounds muriate of potash and 200 pounds nitrate of soda per acre. The potash and phosphoric acid should be appied before seeding and thoroughly mixed with the soil. The nitrate can be used as a top dressing afterwards.

There are several good varieties of turnips. The flat rooted are the earliest and generally the most profitable where quick maturing is necessary. For spring planting these are the best. They are also to be used in fall planting if there is danger from hard freezing in the early autumn, but for the most profitable feeding crops the globe varieties are the most desirable. They may be planted almost any time from February to September in the southern states, and will remain in the ground all winter. These are known as Swede turnips, or rutabagas. They will yield 500 bushels per acre, when the flat varieties under the same conditions will not produce over 300 bushels. They get sweet and juicy after frost, while the flat ones become corky and tasteless.

A Michigan farmer says he could never get a stand of timothy until he sowed the seed with turnips. He plowed up the wheat stubble in July and sowed the seed in August. The crop produced about 100 bushels of good marketable turnips per acre and left as much more standing on the ground. The next spring the old turnips rotted and fertilized his grass seed so that he had a fine crop of timothy. The leaves had served as a mulch against hard freezing during the winter and in the early spring, while the turnips decayed and supplied food for the timothy. This was after he had harvested 100 bushels from an acre. Here is an important lesson in sowing fall turnips and grass seeds.

Turnip seed may be purchased of any seedsman for about 40 cents a pound. If sown in drills and thinned out, one pound is enough for an acre, but broadcasting requires two or three pounds to the acre. In Kentucky our old custom was to sow turnips on July 25th, rain or shine. Of course the seed may be sown earlier or later in different sections. It is best to sow just before a rain, if possible. If broadcasted, they should be lightly covered by brushing or other methods. When sown in drills the depth is easily gauged by the machine. For fine marketable turnips the drilling in rows and thinning out by hand is the best method. Broadcast sowing is good when only home feeding crops are wanted, and some are left to fertilize the land. JOEL SHOEMAKER.

IRRIGATION.

GOVERNMENT IRRIGATION.

In considering the subject of irrigation as a function of government, we must first briefly review the facts and conditions that have given rise to the practice of irrigation.

From time immemorial those agricultural sections, which have depended on the natural rainfall for the supply of water required to raise their crops, have been subject to fluctuation between the greatest extremes of prosperity and adversity, owing to the great success or total failure of agricultural crops.

Very early in history men sought to provide against the famine produced by the failure of the natural water supply, or lack of rain. So long ago as the time when Egypt was ruled by a son of Israel, whose interpretation of Pharaoh's dream prevented famine in the land, rulers have sought to protect themselves and their people against the uncertainty and probable disaster resulting from absolute dependence on the rainfall for the needs of the agricultural crop.

While the valley of the Nile is one of the most ancient as well as fruitful sites for agricultural industry, and while it has not wholly depended on rainfall for its fertility and productiveness, it did not in ancient times attain its period of highest production.

It remained for the British government, which is in control in Egypt to construct, during the closing years of the nineteenth century, the great dam at Assouan, on the Nile, the chief purpose of which is to hold back and store the flood waters that they might be available during the dry seasons.

This great dam is the largest and most expensive irrigation work that has ever been constructed, and it is estimated that the additional land brought under cultivation will return to the government from the outset reaaonable interest on the outlay, and eventually repay them the entire cost of construction.

For several reasons the accomplishment of this work could never have been realized by private capital.

This work was constructed across a navigable river, over which the government only had control, and while locks had been built for the passage of vessels, the working of these impediments to navigation could be practicable only when in the hands of the government.

The plains of Northern India, a comparatively few years ago, showed to the British government the crying need of practical and adequate systems of irrigation.

For more than two thousand years the natives of India have endeavored, when the rainfall failed, to irrigate from numberless wells and small reservoirs, but here the means at hand were so insufficient for the area to be treated and the population to be supported, that famine was not uncommon.

It remained for the British government to adopt methods of irrigation on a systematic and adequate scale.

The first English irrigation works in India were undertaken by private parties and were failures financially.

The great plains of Northern India have an annual rainfall of from 25 to 30 inches, which seems quite sufficient for the wheat and even the upland varieties of rice which are cultivated on these lands. But while the annual rainfall may be 30 inches, three-fourths of it may fall in a single night, thus either destroying the crops or running off so quickly that no use can be made of it. So the British government, by a system of canals and ditches, dams and reservoirs, has saved or used this great rainfall, thus making it a blessing where before it was an injury.

Dams have been thrown across the principal rivers to retard the water, while canals leading from these reservoirs conduct the water over the country, sometimes crossing smaller water courses until it is finally used up in irrigation.

One of the most notable of the North Indian dams is the Soane dam, thrown across the river Soane at Dehree, in the province of Bervah in upper India.

The river at this point is 2½ miles wide and its naturally steep, well-defined banks rise 25 or 30 feet above the bed of the river. Its banks, like those of the Sacramento river, in the great valley of California, and in fact like all rivers flowing through a moderately level county, are higher than the surrounding plain, so that the river flows, as it were, along the crest of a ridge or backbone through the country.

The bed of this river is of shingle or coarse sand and shale to a great depth, and when emerging from the highlands has a fall of from one and one-third to three feet per mile.

In flood the raise of water is from 14 to 20½ feet and the discharge at the junction with the gauges is 1,000,000 cubic feet per second, so that in wet weather there is great probability of this water becoming an injury rather than a blessing.

In the dry seasons of the year its discharge is less than 4,000 cubic feet per second. In March of 1875 the water was at its lowest level and ran in shallow tortuous channels through the heavy, white sands of its bed.

In such years of drought, if there are no artificial means of irrigation, famine is inevitable, and in such a densely populated country the horrors of famine may be readily appreciated.

In Italy the great irrigation works are likewise owned and controlled by the government. The great Cavour canal, taking water from the Po river, was originally undertaken by private parties with various concessions in their favor, but the actual cost so far exceeded the estimated cost that eventually the project came under the control and successful management of the government.

In France and Spain there have been irrigation works for centuries, most of which have been in the hands of associations of land owners, but in both of these countries there is a tendency toward strict and more complete governmental control of these works, in recognition of the fact that supply of water for irrigation purposes is, where such is the public need, quite as much a public utility as the supply of water for domestic use.

In the settling of the territory acquired by the United States from France and Mexico, the home-seekers halted at the one hundredth meridian of longitude, because beyond that they found the rainfall insufficient to mature their crops.

Not until many years later did the settlers realize that the rivers flowing from the snowclad peaks of the Rocky Mountains contained water, which if diverted, would render a great area capable of agriculture.

Beginning where the people one thousand years ago left off, they have in a measure reclaimed the desert.

In this way 7,000,000 acres of land have been irrigated, but this method is fast reaching its limit.

Drawing a line north and south through the middle of the two Dakotas, Nebraska Kansas and Oklahoma, we may find the land west of it comparatively arid, which aridity increases as the mountains are approached. This region was once called the "Great American Desert."

The waters which are available for irrigation, must come from the snows of the mountains. Most of this snow melts before the month of May, leaving a scanty supply for the hot months of June, July and August, when moisture is needed for maturing the crops. The condition of

these streams at this time is the highest possible measure of reclamation without the storage of storm water. The flood waters or freshets are of no value, for they are not available when needed.

The question now comes from different sources, "Why should the government undertake the irrigation of these lands?" and the question is generally accompanied by the suggestion, "Why not leave it for private enterprise?" There are conclusive answers for both suggestion and question:

The limit of private enterprise has already been reached.

Small areas of land bordering on running water available for irrigation may be easily kept under cultivation by the small supply of water, but nothing adequate and systematic can be accomplished by private parties.

Most projects of the kind have proved financial failures, although as shown in the report of the United States Geological Survey, many bankrupt enterprises have created great values and conferred great public benefits.

The financial failure of these private ventures has been due mainly to the great cost, the slow returns, and to the fact that the projectors could not own and control both the land and the water supply. All of which are vital points in the consideration of this subject. This may be done by the government through its original ownership of the lands and its greater facilities and more ample means for the construction of reservoirs and irrigation works. In these circumstances we find abundant reason why the reclamation and irrigation of these arid lands are properly within the scope of government work.

The government owns 6,000,000 acres of arid and semi-arid lands, and it is the duty of the government to open these lands to settlement. In order to do this all that is necessary is to save and store the snow and storm waters and provide means for conveying them upon the land, in order that they may be within the reach of the home-seekers who settle these lands. This the government can and should do. We have found reasons why private enterprise could never accomplish this, and we can find good and sufficient reasons why the state could not do it.

In the first place the states do not own the land in question. In the second place if the national government could turn over to the states the ownership of these lands, interstate disputes would arise concerning the waters of some river which are used by two states for irrigation purposes. Such a case is at present in litigation between the states of Colorado and Kansas, in the supreme court of the United States. Again disputes would arise over the question of diverting the waters from a watershed, the whole of which does not lie in either state. All of these hitches in the machinery of systematic irrigation would be overcome if placed under the control of the national government.

Another great question arises, "How are these works to be paid for?" The irrigation bill concerning this provides that the already reclaimed lands shall be sold to the actual settler in small tracts of not less than 40 acres, and not exceeding 160 acres, the price to be fixed by the Secretary of the Interior as to be payable in ten yearly instalments, so that the money expended in the construction of one work on the lands just disposed of, will return and be used again on the construction of another work, thus creating a revolving fund, which renders the scheme self-sustaining, the required end being accomplished without additional taxation on the people.

"How do we know that the reclaimed portions will be settled?"

When we consider that in 1850 our population was 23,000,000, in 1880 50,000,000, and in 1900 75,000,000, it is reasonable to suppose that in the next fifty years it will be more than doubled and at

least one-half will go to the western third of our country.

As to the constitutional right of our government to own and control these irrigation works, the President says: "The storage of flood and storm waters at the heads of our rivers is but an enlargement of our present policy of river control under which levees are built on the lower reaches of these same rivers."

If the government cannot maintain these various forms of activity, it could not vote the money for the relief of the sufferers at Martinique, it could not on the plea of violated humanity intervene between Cuba and the tyrannical rule of Spain on that island, thus if our government could do these things which are for the public benefit, and which tend to maintain the respect held for our government abroad, can it not do this for our own interests?

For the general government to provide means of irrigating the arid lands which it offers for sale to actual settlers, is in harmony, not only with a wise business policy, viewed from the standpoint of dollars and cents and the public treasury, but it is in line with the experience and history of those states and countries whose dry climates and productive soils have made irrigation necessary for the greatest and most complete national development. —ALFRED C. NORTH in the *Press and Horticulturtet.*

IRRIGATION WORK IS BEGUN.

From Sterling, Colo., comes the report that a large corps of government surveyors have begun making a preliminary survey for a ditch to carry water from the Platte river to the great Pawnee irrigation reservoir, which it is believed the government will build. It will require from two to three weeks to complete the survey, and it is estimated the cost of the ditch will be fully $1,000,000. The ditch will be 70 miles long, 6 feet deep, 50 feet wide at the bottom and 75 feet wide at the top.

52,622 FARMS IN SOUTH DAKOTA.

The census bureau has made public a bulletin on agriculture in South Dakota. It shows that in the census year 1900 there were 52,622 farms in the state valued at $220,133,190, and covering an area of 19,070,616 acres, or about 39 per cent of the total area of the state. The live stock held on the farms is valued at $65,173,432 and farm machinery $12,218,680, making the total value of farm property for the state $297,595,302.

The report places the value of farm products for 1899 at $66,082,419, of which $21,906,804 goes to the credit of the live stock product.

KNIGHTS PYTHIAS BIENNIAL MEETING.

For this gathering in San Franciseo in August next excursion tickets will be sold via the Chicago, Milwaukee & St. Paul Ry. from Chicago to San Francisco or Los Angeles for $50 for the round trip with final return limit September 30.

The "Chicago, Milwaukee & St. Paul" railway is the Short Line between Chicago and Omaha. Two through trains daily in each direction with the best Sleeping Car and Dining Car Service, and all regular travelers know and appreciate the merits of the Chicago, Milwaukee & St. Paul Railway's Short Line between the East and the West.

Time tables, maps and information furnished on application to F. A. Miller, General Passenger Agent, Chicago.

CORRESPONDENCE.

A MODEL FARM.

The following letter was received from J. F. Mayes, manager of the Texas Challenge Windmill Company, Dallas, Texas, in response to our request for information regarding their state fair project:

IRRIGATION AGE, CHICAGO, ILL.:

Gentlemen: Replying to your esteemed favor, will say in regard to our state fair project that we expect to put in at the Texas State Fair as a permanent feature thereof a model irrigation farm in miniature. The water for irrigating the crops will be drawn from a depth of 60 feet dy windmills and gasoline engines and the water distributed over the farm by means of ditches. The grounds will of course be laid off in an artistic manner with a view to making it pleasing to the eye from the standpoint of a landscape gardener and the crops will be arranged with a view to heightening this effect in every possible way. The crops will be grown from the choicest seed obtainable and the principal idea will be to demonstrate in a practical way just what can be done with different crops by a proper system of irrigation. The space allotted to any one crop will necessarily be limited, but for demonstrative purposes it will be as valuable as if the crops were larger.

The soil on which the state fair grounds is located is an average sample of what is known as the Texas Black Land Belt. The city of Dallas is located in the heart of this belt of extremely rich soil, and even without irrigation nearly all varieties of crops respond to the efforts of the husbandman more abundantly in this particular soil than anywhere in the United States. The only difficulty ever met with is the lack of rain, and when artificial methods are employed to obviate this difficulty this particular soil is a veritable gold mine. So far there has been very little done with a view to determining the results of irrigation, which is owing principally to the fact that this is comparatively a new country and has been settled up by people who come from the older southern states where it was necessary to use an immense quantity of fertilizers in order to produce crops of any kind. Their experience with the black waxy soil of Texas has been so strikingly different to what they were used to, that they are inclined to let well enough alone. In other words the soil here responds so bountifully even under natural conditions, compared to what it does in some other states, that no one has felt disposed to see just how much profit could be developed if every possibility were taken advantage of. During the present year all feed crops were practically a failure for lack of rainfall. The rains of the past thirty days, however, have so improved the conditions of our great staple, cotton, that the people have entirely forgotten their loss in the matter of grain crops. With the proper system of irrigation, even by pumping from considerable depth, these grain crops could have been saved, and this particular section several million dollars better off.

The same thing would be true of nearly any year, because we never have seasons so favorable, but that the losses on account of drouth would be astounding if figured out in dollars and cents. Our idea is to encourage an agitation of this subject with a view to saving these immense amounts for our farmers. If you have any suggestions to offer in regard to our exhibition farm, we would very much appreciate the same.

The machinery to be used in this exhibit is manufactured by the Challenge Windmill & Feedmill Co., Batavia, Ill.

CO-OPERATIVE CANAL.

A letter from D. B. Hartwell, secretary of the Cedar Canal Company, Ltd., gives details of their irrigation enterprise at Rosworth, Idaho:

EDITOR IRRIGATION AGE:

Dear Sir: In reply to your letter I will say that our enterprise belongs to the class of small schemes promoted by the co-operative labor of the stockholders.

The canal has a capacity sufficient for the irrigation of 2,500 to 3,000 acres. All the stock of the company has passed to private owners, and all water rights are obtained only by purchase of company stock from present holders, thus a purchaser becomes a stockholder in the company and receives his proportion of all water the canal furnishes. There is no renting or sale of water by the company.

Our location is in the heart of the winter range upon some of the best agricultural land in the state and is adapted for general farming and stock raising. Young orchards have bloomed for the first time since planting two years ago, giving every indication of success in fruit raising. The fact that all kinds of stock have wintered on the range during the past six years (to the writer's personal knowledge) is sufficient evidence of climatic conditions

The utilization of a reservoir site 13 miles above this location would store the flood water of several streams in quantity sufficient to irrigate a township when the required capital and labor shall have combined to finish what nature has so well begun.

The land in this vicinity has recently been surveyed and wasopened for entry the 9th of May. A few of the present stockholders have limited amounts of stock to sell, and all holders of stock have begun or contemplate the immediate beginning of improvements of their homes.

SUNNYSIDE, WASH.

We give herewith an extract from a letter received recently from R. K. Tiffany, of Sunnyside, Wash., concerning that section:

"The Washington Irrigation Company has 42 miles of main canal carrying 600 second feet of water besides 25 miles of large laterals and over 200 miles of distributaries. A 20-mile extension on the main canal is progressing at the rate of a mile and a half per month. In all, 60,000 acres to be reclaimed, one-third now under cultivation. Hay lands clear over $20 per acre per year; orchards $400 to $1,000 per acre per year: raw land selling at $40 to $75 with water-right.

"A splendid example of what irrigation will do for desert land, for this was formerly called the Yakima Desert."

FROM WYOMING.

EDITOR IRRIGATION AGE:

Dear Sir: The *Boone News* of Iowa of July 16th contains an editorial on the meeting of the executive council at the capital of the state to take action in the assessment of Iowa railroads. The turn has been taken that there should be higher assessmont for farming land rather than for railroad property. Judge J. L. Stevens of Boone, principal attorney for the Northwestern railroad, was the principal speaker. Statistics as to the value of farm property along the C. & N. W. railway were presented, taken from the records of the several counties through which the road passes. These records show that $62.50 is the average price at which farm land has sold during the past six months per acre. It was shown that land had increased in price since last September $7 to $10 per acre. The Judge held the opinion that only the cheapest land had been sold, and that Iowa land was actually worth $100 per acre. This seems almost incredible to one who has bought several thousand acres of the government at $1.25 per acre in times past, and this state of the value of Iowa land in the face of a

partial drouth last year and swamps and floods this year.

The comparison I wish to make and the conclusion to arrive at are these, as compared with Wyoming lands: Why should not land in Wyoming properly irrigated be worth as much as land in Iowa? Everything can be raised here that can be produced on Iowa farms, excepting, perhaps, their kind of corn. Here a farmer can pursue his calling without fear of excess of rain or a drouth, if he knows how and when to apply water, which is supposed to be ready at all times by irrigation ditches. These facilities can be furnished at a cost of $10 per acre.

Testimony can be given of men in this vicinity who have farmed in Iowa, that they prefer Wyoming farming under irrigation. One person who has farmed here a number of years, under a spring that supplies water, states that land here is worth more than the best Iowa land, because the products bring better prices at a home market, and they have a good range for stock at small cost.

It is believed that under the new irrigation act passed by Congress at its last session, Wyoming will be greatly benefited and prosper. The land suitable for agriculture will in a short period be irrigated and used for farming purposes.

The Denver *Weekly Republican* of July 17th has an article on the "Wealth of Wyoming." It states: "In the course of time the agricultural interests of Wyoming will receive the attention they deserve, for it has large streams and probably more water available for irrigation than even Colorado." Under the new irrigation law recently enacted by Congress much work of this kind should be done in Wyoming, thus opening the way for the reclamation of thousands of acres that when watered would be exceedingly fertile.

Very truly,

CHAS. A. SHERMAN,
Alcova, Wyo.

Dr. A. C. True,
Director Office of Experiment Stations, U. S. Department of Agriculture.

THE IRRIGATION AGE.

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THE IRRIGATION AGE.

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A monthly illustrated magazine recognized throughout the world as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world, and has no rival in half a continent. It advocates the mineral development and the industrial growth of the West.

D. H. ANDERSON, - - Editor.

A. C. True, Ph. D. Alfred Charles True, Ph. D., whose portrait we present to our readers this month, was born at Middletown, Connecticut in 1853, being a son of Rev. Charles Kittredge True, D. D., for many years a professor in Wesleyan University.

He received a classical and scientific education at Wesleyan and Harvard Universities and for a number of years followed the profession of teaching, principally at the State Normal School at Westfield, Massachussets, and Wesleyan University. At the latter institution he was associated with Prof. W. O. Atwater, the distinguished agricultural and physiological chemist.

When the office of experiment stations was created in the Department of Agriculture in 1888, under the directorship of Prof. Atwater, Dr. True was appointed editor in that office. He was successively promoted to be assistant director in 1891 and director in 1893. For some ten years he was the chief editor of the Experiment Station Record. Under his administration the functions of the office of experiment stations have been greatly broadened and it now ranks with the main bureaus of the Department of Agriculture. This office represents the department in its relations with the agricultural colleges and experiment stations, which are now in operation in all the states and territories, and directly manages the experiment stations in Alaska, Hawaii and Porto Rico. It seeks to promote the interests of agricultural education and investigation throughout the United States.

Dr. True has made a specialty of studies relating to the organization and development of institutions for agricultural

education and research. He has been an active member of the standing committee on Methods of Teaching Agriculture of the Association of American Agricultural Colleges and Experiment Stations, which has been an efficient aid to the development of stronger and better courses in agriculture in our agricultural colleges. He is at present dean of the Graduate School of Agriculture, which recently held its first session at the State University at Columbus, Ohio.

When the first appropriation for irrigation investigations was made by Congress, the general supervision of this enterprise was assigned to Dr. True, by Secretary Wilson, inasmuch as the work was to be conducted, in a large measure, in co-operation with the agricultural colleges and experiment stations. Dr. True immediately called a conference of the directors of experiment stations and state engineers in the irrigated region. This conference was held at Denver and the plan of operations there presented and discussed was made the basis of the irrigation work of the Office of Experiment Stations, which has since been elaborated and developed under the immediate charge of Prof. Elwood Mead. Dr. True keeps in touch with this and other lines of his broad work by personal visits from time to time to the leading centers of this work in the different states and territories. For this purpose he spent some time in California in May of the present year.

An Article by Judge Kinney. We anticipate being able, a little later on, to present to our readers an article from the pen of Judge Clesson S. Kinney, of Salt Lake City, Utah, dealing with the effect irrigation has had upon modern civilization. As Judge Kinney is standard authority on prehistoric and modern irrigation the article in question will be both interesting and valuable. Judge Kinney is at present engaged in preparing another work.

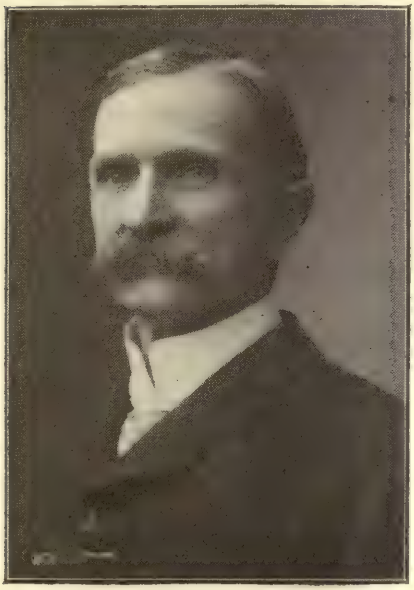
"Up to" the States. William E. Smythe, author of "The Conquest of Arid America," etc., and formerly editor of the IRRIGATION AGE, conducts a department in "Out West," formerly "The Land of Sunshine," the August number of which contained an excellent article entitled "The Battle of the States." This gives an outline of what has been accomplished for the cause of irrigation since the movement began twelve years ago, culminating in the substantial result achieved by the passage of the Newland's Act. Lack of space forbids us quoting as copiously as we would like from this very interesting article, but we give a few extracts from it:

"The nation has decided to make the people's heritage available for the people's use. * * * * * Without taking time to detail the process by which a revolution was wrought in public sentiment, it is well worth while to note how it has carried us in precisely the opposite direction to that in which we were traveling twelve years ago, and even many years later. The legislation actually enacted in June, 1902, reverses all the tendencies which marked our former irrigation development. It puts public works in place of private works and public enterprise in place of private speculation."

Regarding the responsibility which rests upon the States it is said that the President in his message concerning the Newland's Act "declared that the several states should receive national assistance 'only as they showed themselves fit to receive it.'" Such states as are fit, the article claims, are "only such as can guarantee that when the Nation shall have stored the water in the mountains and turned it into the common flood of the streams at the time of need, the water so obtained shall be delivered to the settlers for whom it was intended. * * * * * In a word, the success of our new National policy hangs upon the outcome of water

reform in the West. And thus the whole question is 'up to' the States."

C. E. Wantland. The success of the Tenth National Irrigation Congress may be attributed mainly to the persistency and push of C. E. Wantland, of Denver, Colo., chairman of the Executive Committee of the congress, whose portrait



C. E. WANTLAND.

is shown in this issue. Mr. Wantland is representative of the Union Pacific Railway Land Co. at Denver and Salt Lake City, and is publisher of that lively and interesting paper "Ranch News."

Encouraging Reports. Dun's review of trade for the week ending Sept. 13, was very encouraging. All industries are busy and good times are prophesied. Large crops are being harvested and the greater abundance of foodstuffs caused a decline in prices of commodities during August of 3.5. Lack of cars hampers shippers and the transportation facilities are very inadequate; despite the rapid development that has been made along this line.

Bradstreet's report for the same period says: "One fact brought out in the reports as to activity in dry goods, clothing, shoes, millinery, and groceries is the general demand for a higher class of goods which manifests itself.

"Government and private advices as to crops of cereals, fruits and tobacco are quite encouraging for a large yield. The quality of oats will be below the standard owing to the wet weather in harvesting, and much winter wheat is below grade. The reduced movement of hogs to market is apparently based upon fewer animals on the farm. Rice yields will be liberal in the south, and sugar cane is making good progress. Dry weather will reduce the crop of citrous fruits in Florida.

"Another notable feature is the general strength exhibited by prices. The smallest stock of wheat supplies since 1898 is indicated both here and abroad. It has been a weather market for corn, reports of damage yet to come from frosts inducing a fractional gain on the week. Cotton goods are firmer, as much because of the steady insistent demand as because of the strength of the raw material.

"The situation in wool and woolen goods is favorable to sellers. The strength in hides is the keynote to the leather and shoe markets. A feature in keeping with the advancing season is the higher range of farm produce. Eggs are higher and butter is advancing on larger consumption and reported manipulation by cold storage interests."

Forest Fires in the West. Reports from Oregon, Washington and British Columbia tell of destructive forest fires which have caused enormous loss of property and some loss of life. Mills, lumber and timber to the value of $1,000,000 were destroyed in Chehalis county, Washington.

Bridges and fences were attacked and residences threatened in South Portland.

The sawmill of the Bridal Veil Lumber company and the whole town of Palmer, situated twenty miles east of Bridal Veil, were destroyed.

The damage in eastern Multnomah county amounts to $42,500. The most valuable timber belt in Clackamas county, Oregon, is practically burned out. The towns of Elma and Folsom, in Chehalis county, Wash., have been partly destroyed.

A Striking Poster. We have received a poster from "Gouvernement Général De L'Indo-Chine, Francaise," announcing the Exposition to be held at Hanoi, French-China this year. The poster is striking in colors and is, in its way, a curiosity.

MY MENDING BASKET.

It is made of the stoutest of willow;
It is deep and capacious and wide;
Yet the gulf stream that flows through its borders
Seems always to stand at flood-tide!

And the garments lie heaped on each other;
I look at them often and sigh,
Shall I ever be able to grapple
With a pile that has grown two feet high?

There's a top layer always of stockings;
These arrive and depart every day;
And the things that are playing "button-button"
Also leave without any delay.

But ah, underneath there are strata
Buried deep as the earth's eocene!
Things put there the first of the autumn,
Still there when the trees have grown green!

There are things to be ripped and made over;
There are things that gave out in their prime;
There are intricate tasks—all awaiting
One magical hour of "spare time."

Will it come? Shall I ever possess it?
I start with fresh hope every day.
Like a will-o'-the-wisp it allures me;
Like a will-o'-the-wisp fades away.

For the basket has never been empty,
During all of its burdened career,
But once, for a few fleeting moments,
When the baby upset it, last year!

—Bessie Chandler in Harper's Bazaar.

TENTH NATIONAL IRRIGATION CONGRESS

"FORESTRY, HARMONY AND COLONIZATION."

Preparations for holding the tenth session of the National Irrigation congress at Colorado Springs, October 6 to 9 inclusive, of this year are going vigorously forward. C. E. Wantland, chairman of the executive committee of the congress, and Hon. F. C. Goudy, member of the executive committee of the congress for Colorado, both of Denver, and Secretary McClurg, of the chamber of commerce, who is chairman of the committee on local arrangements for the National Irrigation congress, are now devoting the greater part of their time to the necessary preparatory work.

While it cannot be promised that President Roosevelt will attend the congress in person, it is understood that he will prepare an address to be read before the delegates, and he is in entire accord with the holding of the congress at this time. It is likely that a large attendance will be present, and to that end all railroads in the Western Passenger association and in the Transcontinental Passenger association have made rates of one-half fare plus $2 for the round trip from all points in this territory, and these special rate tickets will be good returning from Colorado Springs up to October 31.

Letters have been sent by the executive committee and others to all of the leading papers of the sixteen western states directly interested in the reclamation of the arid regions, requesting them, editorially and locally, to make known the holding of the irrigation congress at Colorado Springs in October, and very many of these journals have already complied with the request, the subject being of the primest importance to the people of the "Greater West."

It is planned to devote an entire day on the program to the discussion of the national irrigation act, its operations and possibilities. It goes without saying that the leading irrigation experts in the country will be on hand to take part in the discussion, and all the senators and congressmen of the states and territories in the arid region have especially been invited to be present and join in the program and debate.

Governor Orman has been invited, and it is expected will deliver an address of welcome to delegates, followed by Mayor Robinson of Colorado Springs, welcoming them to the foot of Pike's Peak.

Hon. Thomas F. Walsh, president of the National Irrigation congress, who is now in Europe visiting Leopold, the king of Belgium,

last week cabled to the chamber of commerce a handsome subscription to further the local work and details of arrangements.

The vice presidents of the congress are ex-Governor Prince of New Mexico and Mr. F. B. Thurber of New York city. There are vice presidents and also members of the executive committee from every state and territory.

An official call, asking governors, mayors, county commissioners, chambers of commerce and other business mens associations, horticultural, arboricultural and irrigation associations, etc., to appoint delegates to this congress.

OFFICIAL CALL.

The Tenth National Irrigation Congress will be held at Colorado Springs, Colo., Oct. 6th to 9th, 1902. We shall celebrate a great victory, but we must consider the new responsibility placed upon the West by the National Irrigation Act, under the provisions of which the proceeds from public lands will hereafter be devoted to the reclamation of the arid lands in the sixteen states and territories affected, viz: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington and Wyoming.

The importance of this great act of constructive legislation—secured by the united action of the friends of National Irrigation regardless of politics—is not yet fully appreciated, even in the states most directly concerned. An entire day of the Congress will be devoted to the National Irrigation Act—its operation and possibilities and leading Irrigation experts and business men of the country will be in attendance and take part in the discussions.

The American Forestry Association will meet with the National Irrigation Congress, and Forestry will be given proper attention. Colonization, so important to the Western States, and heretofore practically neglected at Western Conventions, will be handled vigorously. Harmony in the West must be secured if we are to receive the greatest benefits from the National Irrigation Act.

A magnificent program for the Congress is assured. Local arrangements for the entertainment of delegates will be complete and satisfactory. Favorable railroad rates have been arranged.

Newspapers of the country are urged to give publicity to this call, and to keep before their readers the importance of the Congress. Governors of States, Mayors of Cities and officers of the organizations entitled to appoint delegates, are urged to act promptly, and to select men who are enthusiastic for Western developments.

The basis of representation in the Congress will be:

The Governor of each State and Territory to appoint 20 delegates.

The Mayor of each City of less than 25,000 population 2 delegates.

The Mayor of each City of more than 25,000 population 4 delegates.

Each Board of County Commissioners 2 delegates.

Each Chamber of Commerce, Commercial Club, or Real Estate Exchange 2 delegates.

Each organized Irrigation, Agricultural and Live Stock Association 2 delegates.

Each Society of Engineers 2 delegates.

Each Irrigation Company and Agricultural College 2 delegates.

The following are delegates by virtue of their respective offices:--The duly accredited representative of any foreign nation or colony; the governor of any state or territory; any member of the United States Senate and House of Representatives; member of any State or Territorial Commission; all members in good standing of the National Irrigation Association.

BY ORDER OF THE EXECUTIVE COMMITTEE.

Address communications concerning the general work of the Congress to C. E. Wantland, Chairman Executive Committee, 1025 17th Street, Denver, Colorado. Concerning local arrangements at Colorado Springs to Gilbert McClurg, Chairman Committee on Arrangements, Colorado Springs, Colorado.

OFFICERS.

Thos. F. Walsh, President, Washington, D. C.

L. B. Prince, First Vice-Pres., Santa Fe, N. M.

F. B. Thurber, Second Vice-Pres., New York City.

H. B. Maxson, Secretary, Reno, Nev.

Gilbert McClurg, Chairman Committee on Arrangements.

George H. Maxwell, Executive Chairman National Irrigation Association.

State Vice-Presidents:—Arizona, W. J. Murphy; California, F. Q. Story; Colorado, Gilbert McClurg; District of Columbia, E. F. Best; Idaho, W. E. Pierce; Illinois, James E. Daley; Iowa, T. J. Hudson; Kansas, William H. Barnes; Massachusetts, Dwight B. Heard; Michigan, Prof. H. K. Vedder, Minnesota, W. W. Heffelfinger: Missouri, Henry R. Whitmore; Montana, W. M. Wooldridge; Nebraska, John S. Knox; Nevada, John Sparks; New Mexico, Dr. F. E. Olney; New York, F. E. Dawley; North Dakota, J. F. Wallace; Oregon, E. M. Brannick; South Carolina, Judge Smyth; South Dakota, Chauncey Wood; Texas, J. A. Kemp; Utah, L. W. Shurtliff; Washington, Arthur Gunn; Wyoming, C. T. Johnston.

NATIONAL EXECUTIVE COMMITTEE.

C. E. Wantland, Chairman; F. C. Goudy, Chairman Finance Committee: C. J. Gavin, Secretary.

B. A. Fowler, Phœnix, Ariz.; Scipio Craig, Redlands, Cal.; F. C. Goudy, Denver, Colo.; Gifford Pinchot, Washington, D. C.; C. B. Hurtt, Roswell, Idaho; John H. Fowler, Chicago, Ill.; M. E. Jordan, Clinton, Ia.; W. A. Smith, Walker, Kan.; Herbert Myrick, Springfield, Mass.; F. B. Smith, Detroit, Mich.; F. W. Wilsey, St. Paul, Minn.; Tom L. Cannon, St. Louis, Mo.; I. D. O'Donnell, Billings, Mont.; Euclid Martin, Omaha, Neb.; J. E. Stubbs, Reno, Nev.; C. J. Gavin, Raton, N. M.; T. S. Underhill, Antelope, N. D.; D. H. Stearns, Portland, Ore.; E. L. Tessier, Jr., Charleston, So. Car.; Wesley A. Stuart, Sturgis, So. Dak.; Tom Richardson, Houston, Tex.; F. J. Keisel, Ogden, Utah: O. R. Holcomb, Ritzville, Wash.; Fred Bond, Cheyenne, Wyo.;W. C. Nones, Louisville, Ky.; James Kilbourne, Columbus, Ohio; J. C. Brady, Wheeling; W. Va.; G. W. Atherton, State College, Penn.; At Large, G. H. Maxwell, Chicago.

DROUTH AND THE STOCKMENS' REMEDY.

By a resident C. E., Laredo, Texas.

That a lesson can be learned from the history of irrigation in this district of Laredo, Tex., and that irrigation may be made to serve a greater duty in these semi-arid regions than it has yet done will, I hope, be evident from perusal of these pages.

I propose to give a slight description of the soil and of the start and progress of irrigation in these parts. However, my chief object is to make a proposition how at least the evils of the stock raising business may be mitigated in future. At the present time the herds have mostly all disappeared, either dead from the effects of the year's drouth or shipped to the Indian Territory. Of course there are large exceptions to this statement, as some wiser ranchmen have still both water and grass for their cattle.

The valleys of the Rio Grande are of alluvial soil deposited in prehistoric times when it must have been a great river which passed through forests and lands of rank vegetation. This is evidenced by the coal deposits along its course. The ground generally slopes from the river banks and would in many places appear to a stranger or casual observer as a barren soil where grass would not grow, but a closer observer will notice that the barrenness is merely superficial and that there has formed a hard crust on the surface from which the rain runs off as in the case of the proverbial "duck's back" without showing any good effects. There is a rich soil within reach of the plough, which when once stirred up shows the wealth lying under. That there is no subsoil is a fault which cannot be remedied. This only affects the quantity of water required for its cultivation and no drainage is necessary.

Irrigation as a business was introduced here in 1800 by California and Colorado parties. They managed to get up a company which they controlled; then bought a considerable acreage of land immediately outside the north city boundries. Of this they cleared and levelled about three hundred acres which they purported to irrigate and sell to suit buyers. A pumping station was erected with all its paraphernalia; a large reservoir was dug, which to many looked too low to water the adjacent land, but none dared suspect that these enterprising strangers did not know what they were doing. The lots sold readily, storekeepers disposing of their stock of wares to invest in the new undertaking and seek fortune in grape culture; even sage attorneys joined the boom and became land owners. The price fixed

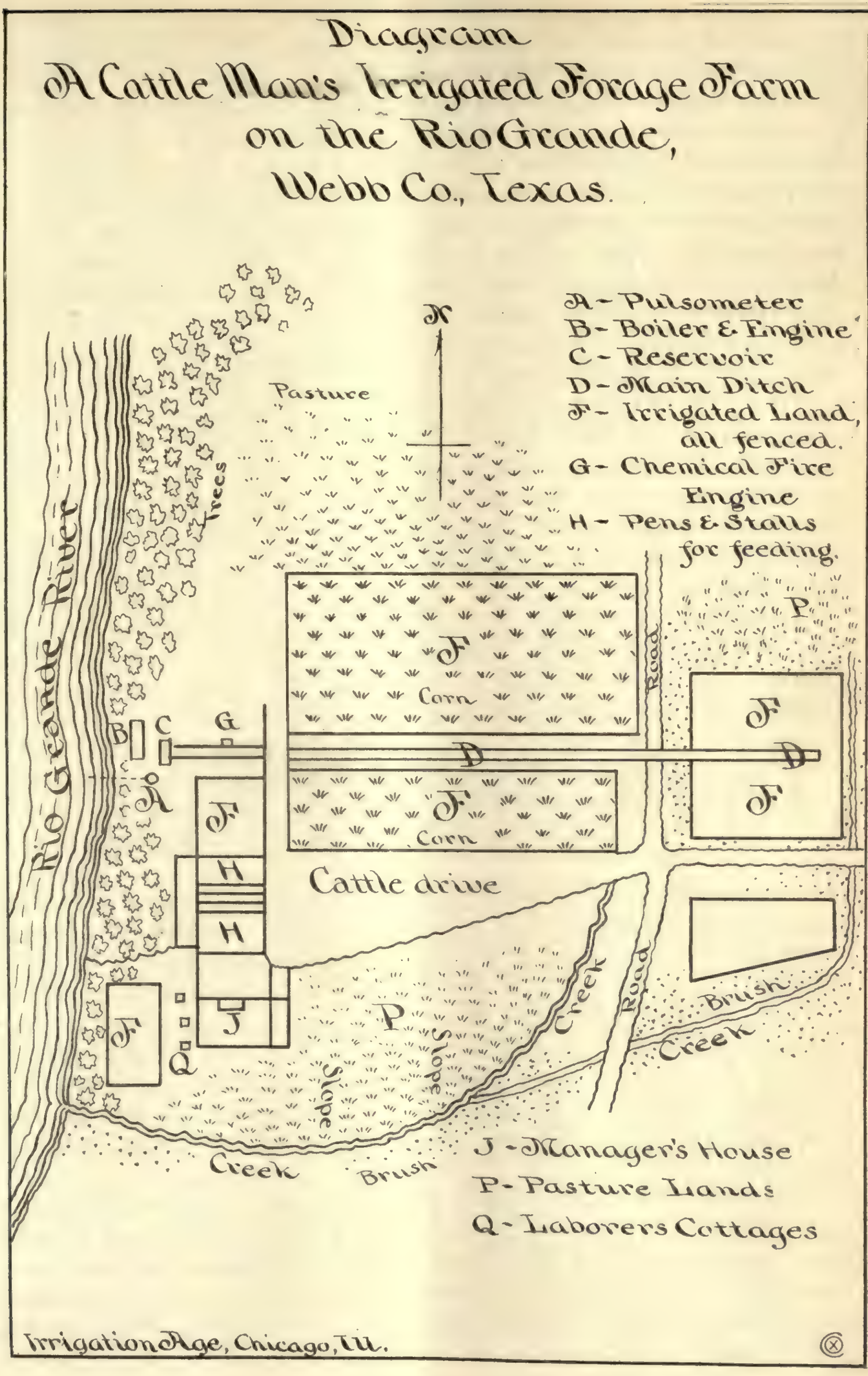


Diagram
A Cattle Man's Irrigated Forage Farm
on the Rio Grande,
Webb Co., Texas.
A - Pulsometer
B - Boiler & Engine
C - Reservoir
D - Main Ditch
F - Irrigated Land, all fenced.
G - Chemical Fire Engine
H - Pens & Stalls for feeding.
N
Pasture
Trees
Rio Grande River
Road
P
F
Corn
D
B
C
G
A
H
Cattle drive
Creek
Road
Brush
Creek
Slope
Slope
J
Q
Creek
Brush
J - Manager's House
P - Pasture Lands
Q - Laborers Cottages
Irrigation Age, Chicago, Ill.

for the land was one hundred dollars per acre, which had cost the company one dollar and fifty cents and the expense of labor in clearing and grading. Grape vines were brought from California and sold to the new occupiers. The two years following were wet seasons, so the quantity of water doled out to the farmers at a high price sufficed in a measure; however; some were dissatisfied and determined to have each his own supply from the river. To do this most of them had to borrow money to put up pumps and power. Here they made the mistake so often made by beginners, viz.: putting up apparatus far too small for their requirements. This had to be remedied and new machinery erected. To make this change they had again to apply to the bankers for loans, so that their properties became loaded with debt from which they never recovered. They found difficulty in disposing of the produce of their farms at profitable prices, so now not one of the original farmers is to be found on this property, though for the first two years the vines produced excellent crops and looked flourishing; in fact when coming into Laredo from the north one would be reminded of a Californian vineyard, but in a short time this ended with the result as stated.

Owing to this failure irrigation was discredited in this district. Fortunately, however, the home farm of the chief promoter had been kept watered and was bought by a farmer who understood his business and who may be called a pioneer, as far as profitable irrigation is concerned in this locality. He brought the place again into good condition; later several of the other farms were bought on favorable terms by parties who know how to work them, and now everything looks green within their fences, whilst all around is parched and barren.

On the south side of the city there were started several independent irrigation farms, none of which remain in order except one owned by a city merchant of ample means; his farm is in a flourishing condition today and he derives from it both pleasure and profit.

At an earlier date about sixty miles south along the river was established a large irrigation farm, the only one well designed of the original group. Here were grown grapes equal to those of European hot houses, but this farm also has been abandoned; it was too far from railway or market and the owner found more profit in other pursuits.

I have only one more farm of the older ones to refer to; it is situated twelve miles from this town and was established by an Illinois man, young, active and intelligent. He bought five thousand acres of land touching on the Rio Grande; grubbed and graded about one hundred acres, erected steam engine and centrifugal pump, all of good make. Everything he planted grew well, but he was seized

with the desire to be a truck farmer; watermelons seemed his favorite and in growing them he was most successful. He sent them to the city in loads of about one hundred melons on each wagon drawn by four fat mules, who with their teamsters would have done credit to a city brewery. "It looked magnificent but it was not" farming for profit. The melons were hauled through town in competition with local gardeners or shipped to agents in distant places who sent no adequate cash returns; so when he had cut down all the trees on his land and was forced to buy fuel for his steam boiler the cost so overcame the income that he had to cease work and now the place lies derelict and the lands unoccupied, as the Mesquite, the only tree of the prairie, like all hardwoods, is of slow growth. In his failure we have a lesson that a truck farm situated far from a populous center or railway communication is out of place and cannot be profitable, whereas, had he given his attention to cattle raising, even on his small pasture he could have supported a considerable number with the aid of his irrigated farm, growing foodstuffs only, allowing all the trees to remain on the ranch, which gave shelter to the cattle; buy all fuel required; keeping his plant and ditches in perfect order, he would have been able to furnish several hundred head of cattle each year for the stock yards. The crops would not require to be hauled off the premises; they would walk. Times of drouth would have been to his advantage.

There is one feature concerning the city of Laredo and irrigation that I think worth recording. It has a population of fourteen thousand. The rainfall for the past two years cannot have exceeded three or four inches; there are six or seven evergreen parks and plazas, avenues of trees, private lawns and gardens growing semi-tropical fruit and flowers, the roses almost unrivalled; all depending on the working of one small steam engine, the water of the Rio Grande, and coal of the neighborhood; yet, notwithstanding high summer temperature and occasional dust storms, is one of the healthiest cities to be found; but it lacks the green hills and fields around which make a place beautiful.

At the present time the prairies are strewn with the carcases of thousands of animals dead from hunger and thirst, only to fatten the buzzard and coyote—both plagues of the ranchman; this is surely an excuse for my proposing a plan which, if carried out, would prevent the recurrence of such misfortune to man and beast. The writer has had long experience as a hydraulic engineer and was trained in the practice and theory of farming by some of the ablest men of their time, and for several years given a close study to the question of irrigation; and as I do not now practice the profession I have no private object to serve.

My proposition is that every ranchman *shall* grow feedstuffs for his own cattle. This only can be done in regions subject to long drouths by irrigation. He must keenly seek for water in his own lands, and will seldom be disappointed, or obtain a piece of land large enough for his requirements on which there is water. Now, just here to allay the impetuosity of the cattleman reader, if such there be, who would say this is nonsense, impracticable and impossible, likely with strong adjectives, I would remind him that it is no new proposition, except in these semi-arid districts. Stockmen in all more northern countries have to provide food for their stock for four or six months every year; and these northern men make as much money as the Texans do. It is true their farms are worked without the aid of artificial irrigation, but their crops are uncertain, whereas those grown in the districts of heat and drouth are certain and on the same land two crops each year. In fact the cattle man is bound to supply his stock with food when his lands refuse to yield the grass necessary, if he will save himself from ruin. How is he to do that unless he grows it on his own lands? Buy it, he may say. Then why do the cattle lie dead of starvation? Simply because he cannot buy it at any possible terms he could accept. It was somewhat different in years gone by when there was no fencing and the prairie was open to all; cattle were at liberty to roam where they would in equality with all other cattle and I suppose their fraternity was almost human, as the most cunning or strongest beast got the most water and best grass, no matter whose brand he had; but now the cattle are closely fenced in pastures where they must live as they can. I write here only of the cold money loss to their owners if they die. Nor will it answer the case to say let the farmer grow the feedstuffs and we will buy what we want. There are important reasons against this plan, which will be shown further on, but first let me say that in such times as now exist the stockman is no longer master of the situation. "The tables are turned," and were there in this district twenty farms such as I shall presently describe, the owners could purchase all the cattle they could support at a low price and make large profits by feeding them, whilst keeping their farms in thorough condition. I think it will be allowed that most ranchmen like to enjoy the profits of good seasons and make little preparations against the bad ones, or if they do anything it is to increase the acres of their holding rather than to improve what they already have.

To preface description of the farm I may say that it was designed to suit particular circumstances of place and purpose. In other situations cheaper and equally effective arrangements could be made. These plans were not accepted by the owners, no doubt for good and sufficient reasons. However, I hold the plan would have given a

compact, well-shaped farm, of easy construction and economical to irrigate. I may further state that the improvements had already commenced when I visited the place. Pulsometer, steam boiler and engine were in position and ready to work. These I included in my design which is outlined by the diagram on another page. The farm is part of a 20,000 acre pasture along the Rio Grande south of Laredo. Viewing this place from the river, the first thing observed is a well built brick tower rising from low water, in which is a Pulsometer of large size. On the bank, 63 feet above, there is a row of buildings; the first is for the steam boiler and engine, the other contains machinery usual in first class farms. Here my design calls for a water reservoir to hold at least three-quarters of a million gallons, or say ten hours pumping of Pulsometer. This is placed as conveniently as possible. Into this reservoir the water is pumped from the river and from it delivered to the different pipes and ditches which carry it to the land, their supply being regulated by sluices. Referring to the diagram it will be seen that the main canal runs almost the entire length of the irrigated land, about three-quarters of a mile. It is three feet wide at top and fifteen inches deep, so that water flowing half full at a velocity of from 70 to 90 feet per minute will deliver 1,000 gallons, which is sufficient for men to handle.

This canal forms a principal feature of the works. It is carried for about 3,000 feet on an earth embankment, which at the western end is eighteen inches high. From this point the height varies with the contour of the ground, giving a fall for the canal of 1 in 1,000. The bottom of the canal is rendered impervious by being of soured, well puddled clay; lining of sides of same material in slabs or tiles, by which means leakage and erosion are reduced to a minimum. The remainder is a wooden flume on tressels, carrying it nearly to eastern end of the farm. The canal viewed from the reservoir would appear a straight streak of silvered glass, as by arrangements only filtered water would be pumped, being easier on machinery, and the mud of the Rio Grande now contains no substance that would benefit plant life, but at times matter which though insoluble becomes by oxidation and time soluble and injurious. The steam boiler is of the ordinary tubular type. For fuel I would use Beaumont oil, as I do not consider it advisable even to partially deplete a pasture of trees unless they are very plentiful. To denude it would be to destroy it for the purpose, as cattle require shade from summer sun and protection from the cold northers of winter, equally as much as they require food, if they are to be kept in condition.

The irrigated farm is to consist of about 250 acres. It can be increased to one thousand on the same plan, but I believe even this acreage is more than the present supply of water will irrigate

unless aided by rains. It is divided into blocks as shown on diagram; the larger ones are situated on either side of main ditch. The land here slopes down from the bank of the river; in 3,000 feet is about seven feet fall on western side, then rises on the eastern side to about three feet, leaving a valley of an arroyo between. The land on the eastern side is richer and has subsoil. It was cut from the thickest brush; trees, branches and roots were burned and the ashes mixed with phosphates carefully spread over the land. To include this part in the farm is the cause of the long ditch and much of the expense. It often occurs that in the construction of such dumps, rats do a great deal of damage causing leakages, but where the bed of ditch is broad and the water sufficient the rodents and their offspring die of drowning and trouble no more.

The shape of the farm here shown is best suited for work as I feel confident that before long plowing, cultivating, and other labor will be done by machinery driven by power. I also look for great improvement in the mode of applying the water to the land. The present system is crude in the extreme. Thus when water is let into a furrow the near end is a perfect mud hole before the water reaches the further end. This causes drills to be made shorter than would be in a non-irrigated farm. All this is especially the case with land such as I am treating of. However, we must use the system we have to the best advantage we know how. In the design water would be conveyed to all cross ditches, wherever practicable, through earthenware pipes or troughs. Through the pipes, where nearly horizontal, would run a loose iron chain which enables men to keep the way clear of siltage.

The cattle would be fed in sheds and pens as shown. These are divided to suit the different classes of cattle and the purpose for which they are being fed. These pens are the great source of fertilizer for the farm, aided by lime, phosphate and kainit or other such artificially prepared fertilizers, applied in the proper manner and time, as the land should always be kept up to its highest productive power.

The design of the farm is such that all the work could easily be carried out in twelve months, by energy and judicious use of the sulky plow, changing what was a grassless prairie into fields of waving corn. The farm could be used at times for growing Bermuda onions and other merchantable crops such as could be sold off in bulk, leaving the land free in May.

One cannot help admiring the wisdom and foresight of the old Spaniards. In making settlements for cities, to each was given a certain quantity of land divided into long narrow strips, each ending on a river. These strips were more than half a mile wide, or more cor-

rectly to state, equal to the side of a square containing one labor, the then unit of land measure in Mexico. Had those people possessed such means of pumping water as we have the face of the country along rivers would have been favorably altered, as they were fully alive to the advantages of irrigation.

I do not for a moment assert that forage farming would pay where fuel and costly machinery had to be employed, if the products had to be hauled off the premises and sold in markets, depriving the land of its tribute, but cattle raising is as hazardous as farming in these districts. It is by means of the union of both systems with irrigation under the one management that we may look for a sound basis to establish a successful cattle ranch. The cattle man will know what is wanted and how to raise it; the value of products of the farm will be estimated truly, not by the dollars they would bring in markets in good seasons, but by the stability it will give the business of stock raising, as the owner will feel confident his cattle will not die of starvation, and that they will be in condition to market at proper time. This confidence will pass to all with whom he has business relations; therefore I believe I do not exaggerate by saying that the irrigated forage farm will double the value of his entire holding.

I fear I have overtaxed the space you can spare for this subject. It has not been treated from an agricultural point of view, as to the best crops to grow, nor from an engineering view as to the best system of machinery to use. On the latter subject I would simply suggest that the best obtainable be employed. The interest, with sinking fund of first cost, will cut but a small figure in the general expenses. It is in fuel that economy must be observed; it is a constant charge. The water should be raised plumb to the height, and no higher than is necessary to fill the reservoir; here the *duty of the fuel ends.*

OLD WINTERS ON THE FARM.

I have jest about decided
It 'ud keep a town-boy hoppin'
Fer to work all winter, choppin'
Fer a old fireplace, like I did!
Lawz! them old times was contrairy! –
Blame backbone o' winter, 'peared like,
Woudn't break!—and I was skeered-like,
Clean on into February! . . .
Nothin' ever made me madder
Than for Pap to stomp in, layin'
On a extry forestick, sayin'—
"Groun'hog's out and seed his shadder!"

—James Whitcomb Riley.

IRRIGATION IN FIELD AND GARDEN.

By Professor E. J. Wickson.

(Reprinted from Farmers' Bulletin No. 138, issued by U. S. Dept. of Agriculture.)

RAISED-BED IRRIGATION.

A very important modification of the furrow system is the raised bed, which, under certain circumstances, is of great value in the vegetaple and small-fruit plantation. The raised bed is an elevation between two irrigating furrows. The field is laid off in narrow lands and several furrows thrown together so as to bring dead furrows about four feet apart, making long beds extending down the grade with their surface raised several inches above the old level. The motive is to arrange a plant bed with a water course on each side and below its surface level (fig. 18). The whole plan is just the opposite of the depressed bed with raised ditches already described, and is obviously to meet quite different conditions. It is especially suited to a rather heavy soil in which water will move well laterally, rise well, and be retained. Irrigation is accomplished by holding water for a time in the ditches. Where the ground is slobing it is held in levels by dirt dams or by the cloth or metal dams already described, placed at intervals as required to raise the water nearly to the ground surface.

Fig. 18.— The raised-bed system for vegetables and small fruits.

The arrangement has several advantages for the market gardener and is largely used by those of foreign birth, who rely upon hand work and desire to carry as many plants as possible per acre;for their rents for rich land near cities are usually high. It enables them to plant in close rows and in starting young plants it gives standing water along-side, which they can easily flirt out with a pan or shovel when they think a little sprinkling is desirable.The Italian gardeners have a knack of doing this which is very interesting.

The chief advantages, however, are the distribution of water beneath

the surface, which lessens the need of surface cultivation, and when the vegetables are well grown obviates the decay which comes to foliage by contact with a moist surface. The same is true of the use of raised beds for strawberries when grown on the heavier loams or when the light, shallow loams overlie hardpan and require frequent irrigation.

Another very important advantage of the raised bed lies in its adaption to growth of vegetables and strawberries during the rainy season of semi-tropical climates. Not only is the raised bed more responsive to the greater warmth which comes to the air at intervals, and consequently promotive of winter growth of vegetables, but it also escapes the supersaturation which long rains may occasion. The deep ditches then act as opon drains for the escape of surplus water. The system would seem to be widely available where there exists both the need of irrigation and the danger of excessive rainfall, according to varying weather conditions.

SUBIRRIGATION AND UNDERFLOW.

Subirrigation is the application of water under the surface by a system of conduits. It has received so much thought and outlay and has returned so little satisfaction that it must be looked upon as a horticultural *ignis fatuus*, and only a passing reference need be given to it. Various available publications[1] describe its different phases. It seems fair to conclude that satisfactory growth is secured with less water by subirrigation than by surface distribution, but it is done at an outlay which is unwarranted either by the cost of water or by the value of the crop. Results of greenhouse experiments are more satisfactory than those from open-air work. Even if even distribution could be had from any arrangement of underground pipes, which seems doubtful in view of wide experience, it still remains true that for shallow-rooting plants in open soils the water is applied at too low a level. It also appears that the escape from the surface cultivation is of doubtful advantage, contrary to the claims of advocates of subirriation, and that thorough surface stirring, which is an indispensable accompaniment of surface irrigation, is worth all it costs through the superior thrift which it induces. It seems a fair conclusion from preent knowledge that subirrigation is practically unattainable because of cost, inequality of distribution, etc., and possibly would be undesirable even if these prohibitions were removed.

Underflow irrigation is quite different from subirrigation, though the former often goes in local parlance as "natural subirrigation."

[1]Subwatering in Greenhouse, Farmers' Bul. 78. Irrigation in Fruit Growing, Farmers' Bul. 116. Surface and Subirrigation Out of Doors, New Hampshire Sta. Bul. 34.

Underflow is a natural movement of water through the subsoil outward from streams or downward from catchment areas toward the country drainage. Underflow irrigation consists in reinforcing this flow, or in imitating it by bringing water to follow the same course of distribution.

It is an available method, first, where the ground water is naturally near the surface and irrigation water is easily obtained in large quantities; second, where an open soil through which water spreads readily is found resting upon an impervious hardpan, or slightly pervious clay, which prevents loss of water by percolation. In both of these conditions the method of irrigation is the same, viz, to open deep furrows at considerable distances apart and keep them filled with water for a considerable time, so that it may soak away in large quantities. The addition will in the first case raise the ground water so that it will rise by capillarity to the plant roots; in the second case the irrigation water will spread through the free soil, flowing along the surface of the hardpan or clay, and will thus become available to plant roots. These methods are most apt to be useful with deep rooting trees and vegetables, but they are also used, where the conditions are favorable, for grains and garden crops.

IRRIGATION BY SPRINKLING.

Irrigation by sprinkling is a method which, so far as the writer knows, is not pursued for any commercial purpose in the irrigated regions of the country. It does, however, sustain itself on the ground of commercial advantage in the Eastern States, as has recently been shown by Professor Voorhees,[1] and the data which he presents should be carefully considered by those who contemplate recourse to irrigation as a protection to high value crops against occasional deficiency in summer rains.

[1] Irrigation in New Jersey, U. S. Dept. Agr., Office of Experiment Stations Bul. 87.

LITTLE JOHNNIE'S ERROR.

Little Johnnie took a mirror
And he licked the back all off,
Thinking: in his childish fancy,
It would cure his whooping cough.

But on the morning of his funeral
The neighbors said to Mrs. Brown,
'Twas a chilly day for little Johnnie
When the mercury went down.

—Boston Traveller.

RICE GROWING IN THE UNITED STATES.

An account which appears to be authentic says that rice was grown in Virginia by Sir William Berkley as early as 1647. No particulars are given, except that from a half bushel of seed planted the product was 16 bushels. Governor Alston, of South Carolina, in an agricultural address (1854) says: "Rice, for which we are indebted to the island of Madagascar, was introduced into Carolina toward the close of the seventeenth century (1694)." Governor Alson states that a few seeds of this Madagascar rice were sown in a garden, which is now one of the thickly-built portions of Charleston, and from that seed came the rice that has made South Carolina famous as a rice-producing state. Ramsay's History of South Carolina states that an English or Dutch ship, homeward bound from Madagascar, was driven by the stress of weather to seek shelter in the harbor of Charleston, and the captain seized the opportunity to visit an old

PLOWING FOR RICE.

acquaintance, the landgrave and governor of the province, Thomas Smith, whom he had already met in Madagascar. Smith expressed the desire to experiment with the growing of rice upon a low, moist patch of ground in his garden, similar to the ground upon which he had seen rice growing in Madagascar, whereupon the captain presented him with a small bag of rice seed which happened to be among the ship's stores. The seed was planted in a garden in Longitude Lane, Charleston, the spot being still pointed out.

Rice production in the United States is limited to the South Atlantic and Gulf states, where, in some sections, it is the principal cereal product. For nearly one hundred and ninety years after the introduction of rice into the United States, South Carolina and Georgia produced the principal portion,

while North Carolina, Florida, Alabama, Mississippi and Louisiana grew only a limited amount. Within the last ten years Louisiana and Texas have increased the area devoted to rice to such an extent that they now furnish three-fourths of all the products of the country. In 1896 Louisiana produced 127,600,000 pounds of rice, North and South Carolina 27,901,440 pounds, and Georgia 10,464,000 pounds.

PUMPING FROM WELLS.

Rice is a plant of such vigor that it could be grown on any arable land as far north as the Ohio river but for three reasons:

Irrigation.—The crop must be irrigated. The smaller tributaries of the rivers that drain the Mississippi Valley bring down very little water during the summer. The same is true of the smaller creeks and streams emptying directly into the gulf. The flood period, or the time of the year when there is greater abundance of water, is not coincident with the period during which the largest amount of water is required by the rice crop. In the absence of lakes or natural reservoirs throughout this region it would be necessary to raise the water from the streams by pumping, and it is an open question whether the water supply would be large enough for any extended area of rice lands.

Moist Climate.—Rice, to attain its best development, also requires a moist climate. With irrigation alone rice would mature among the mountains of Tennessee, but the crop would not compare in quality or quantity with the crops grown along the Gulf and Atlantic coasts, and hence could not compete with the latter in the world's markets. As an example, in Southern Louisiana the winds from the gulf are laden with moisture, but the north winds are dry, and consequently the lands along the south side of a lake or large pond usually produce two barrels per acre more than on the north side, although other conditions of soil and moisture may be equal. Again, the Island of Kiushu, Japan, produces on an average three bar-

rels of rice per acre more than the remainder of the empire. This is because the land is situated where the warm ocean currents first strike the cooler lands and give off a large amount of moisture.

Soil Conditions.—The best rice lands are underlaid by an impervious subsoil. Otherwise the land can not be satisfactorily drained at time of harvest in order to permit the use of improved harvesting machinery. The alluvial lands along the Mississippi Valley in Louisiana are not underlaid by hardpan, and they can not be drained sufficiently to permit the use of heavy harvesters and teams of horses. According to the best estimates there are about 10,000,000 acres of land in the five States bordering the Gulf of Mxieco well suited to rice cultivation. The amount which can be successfully irrigated by present methods, using the available surface and artesian flows, does not exceed 3,000,000 acres. The balance of the land could probably be brought into cultivation were it necessary, but the cost would, perhaps, be prohibitive at present prices.


PUMPING STATION MATAGORDA COUNTY.

Three million acres is a conservative estimate of the amount which can be successfully irrigated. The best results require rotation of crops; consequently only one-half of that amount, or 1,500,000 acres, would be in rice at any one time. At an average yield of 10 barrels (of 162 pounds) per acre, 1,500,000 acres of rice would produce nearly 2,500,000,000 pounds of cleaned rice, nearly six times the amount of our present consumption. It will be noted here that the imports for 1809 show a considerable increase over preceding years. The crop harvested in 1899 is said to be the largest which has ever been grown. Unofficial estimates place it at 300,000,000 pounds. It would appear from these figures that the demand for rice and rice products is increasing in the United States.

James Kray, a commercial traveler, who travels in Wharton and Matagorda

counties, Texas, in an interview recently published in a St. Louis paper, says:

"The development in South Texas rice and sugar fields has been simply marvelous. A short while ago it was all open prairie, with here and there

BAILING RICE STRAW.

bunches of cattle and horses, but now the country is a veritable dream of beauty. The progress in agriculture has been wonderful. There are pumping stations that throw immence volumes of water into irrigation channels for the rice

DITCHING MACHINE AT WORK.

fields. The streams from these pumping plants look like rivers, so great is the flow of water.

"The whole coast country is coming to the front. Rice and sugar are the main agricultural products. Of course, oil leads in the region around Beaumont, but it is in the country southwest of the oil regions where the great de-

A DITCH AND FIELD, HARRIS COUNTY, TEXAS

velopment in farming is going on. There the people are alive to the work of farming by irrigation, and no portion of Texas, or perhaps the entire country, is being more readily developed. There are oil scares and oil booms everywhere

A CANAL IN MATAGORDA COUNTY, TEXAS.

in the coast country, but these people living in Wharton, Matagorda and the contiguous counties are more interested in agricultural development than in winning sudden wealth by boring for an oil gusher. Texas is great, but there

are no greater possibilities anywhere in the state than in the sugar and rice-growing region of the coast."

A CROP WORTH $52 PER ACRE, HARRIS COUNTY, TEXAS.

W. C. Moore, of Houston, Texas, gives the following regarding rice farming:

"To go into the details of rice farming would take up too much time. However, I will state that it requires one man with two ten-inch gang-plows and

RICE IN THE SHOCK, MATAGORDA COUNTY, TEXAS.

four good heavy mules (1,000 or 1,200 pounds) to farm 100 acres. It costs to prepare and plant rice, including the irrigation charges, about $13 per acre. The average yield in Texas and Louisiana is ten or twelve barrels per acre. A conservative price is $2.50 per barrel. These prices will hold good. Rice very

frequently sells at from $3 to $3.50 per barrel for milling purposes, and from $4 to $5 per barrel for seed rice. There is no crop grown in the world that has brought as great prosperity to the homes of the farmers as that of rice. It has made more men rich and more farmers comfortable than any one crop, taking into consideration the acreage, than any ever plantdd on the American continent. There are thousands of acres of splendid rice lands undeveloped in South Texas, which awaits development and offer golden opportunities to those who will avail themselves of the chance. The history of the rice farmers of Southwest Louisiana and Southeast Texas reads almost like Arabian night tales, and in many instances is not believed as being considered reasonable, but nevertheless is a fact.

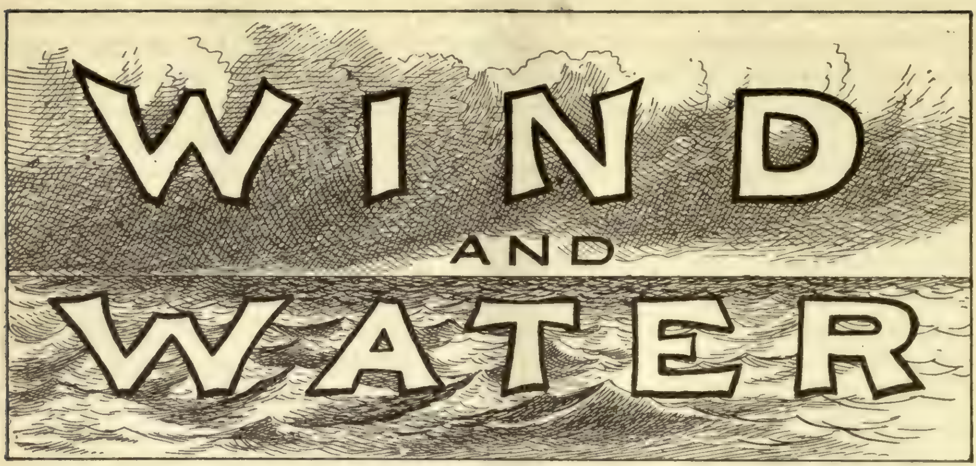
Rice is handled exactly the same as wheat, except one is irrigated and the other is not. A barrel of rice weighs 162 pounds and is sold by that weight,

A TENANT HOUSE IN THE RICE FIELDS.

and a bushel of rice weighs 40½ pounds. A barrel of rice milled gives 100 pounds of clean rice, 20 pounds of bran and 15 pounds of polish. The 100 pounds would be divided as follows: 60 pounds of head rice, 25 pounds of No. 2, and 15 pounds of brewery rice. The bran is splendid stock feed and the polish is used for manufacturing purposes, and is also shipped to Europe for feed stuff.

As regards the soil; this matters but little as far as rice culture is concerned. Any level prairie land with clay subsoil will grow rice of a good quality, and land consisting of a knob of clay and a knob of soil is just as good and will raise just as high quality of rice. It is best, however, in purchasing rice land, which can be done in South Texas in almost any county, to get your land suited to rice as well as other crops, so the farmer can rotate if he cares to do so and which may have to be the case in years to come.

There is no failure in the rice crop, and the farmer can make his calculations as to his income with a certainty that is characteristic of no other crop planted."



IRRIGATION IN MEXICO.

Power irrigation is not only followed extensively in the States but is also carried on to a greater or less extent almost in every portion of the world, and to show that it is even more primitive in some of the older countries than the methods employed in the more modern plants in the States we will describe briefly an odd plant which is installed and in operation in the neighborhood of Guadalajara, Mexico. This plant was installed by one Mora Y. Lopez de Lara, and from information supplied us, the plant is giving the best of satisfaction.

In this section of the country from June to October, included, there is rain in the afternoon each day, as in most of the hot zones. This rain perhaps is greater in some sections than in others and might be described as raining in streaks. Ditches or trenches are stretched out on the land over which rain is expected to fall and the water is collected in the small ditches on the high lands and concentrated into basins located in the lower sections. These basins will hold on an average of about 1,000, 000 gallons and after the rain has fallen and the water has been collected into the basins, the plant is put into operation and by suitable pipe connections from the basins, suction connection is made to a centrifugal pump conveniently located outside of the pump house or engine room, and through properly arranged discharge pipe the water is discharged into the distributing trenches and flows over certain sections of land which are generally used for raising garden truck and the like.

The plant herein described consists of three basins. These basins are connected by suitable pipe from their bottom so that they all have

the same level, and as the water is lowered proportionately in the other two, this gives a large reservoir from which to pump.

The power equipment is a Fairbanks-Morse gasoline driven engine. The engine is located in the small building at the upper right hand corner of the basin and can be seen directly from the front of the door, which in this case is simply an arch way; windows and doors not being necessary. The pump is a centrifugal pump having a 5 inch suction and a 4 inch discharge. The water is lifted 1.2 meters or about 3.95 feet. The pump when operated at its normal speed has a capacity of 450 gallons of water per minute. In each 10 hours this plant irrigates a tract of land of about 20 acres.

For ordinary farm lands in the States a plant with a capacity as above would irrigate from 50 to 70 acres. The difference in requirements between the Mexican irrigation and that in the States is due to the different character of the soil and the extreme heat.

The plant herein described is rather novel on account of the arranging of the basins and the collection of water from the lands that are visited by rain and then distributing it to the portions of land which are best adapted to the raising of garden truck.

The irrigation which we are all more or less familiar with, such as the irrigation in Texas where large tracts of rice land are kept flooded with water for certain periods during the growth, conditions are very much different from those in Mexico. In order to get water in Texas it is only necessary to sink a well and the water will rise within a few feet of the level ground and it is then only necessary to dig a small ditch and attach to the well a centrifugal pump locating the engine conveniently on the ground above, and such plants are generally equipped with a No. 6 centrifugal pump and a 16 or 22 engine, using gasoline or crude oil for fuel.

Owing to the recent discovery of crude oil in Texas the item of irrigating in that section has reduced itself to simply a matter of engineering to install the proper machinery which will handle the required amount of water and do it successfully and reliably. The matter of expense is nominal when the engine is fitted with crude oil attachment using the natural crude oil just as it leaves the well, and this oil is now sold so cheaply that the expense of operating a 20-horse power engine would be only from 20 to 40 cents per day.

Quite a number of these crude oil burning engines were in daily operation this season supplying water to rice fields, and so far as we know the first successful oil burning engines to be introduced in this country, of American make. Various attemps have been made to use the crude oil as it comes from the walls, but on account of the heavy residue it has not been entirely satisfactory, until recently.

Arrangements are now being made to ship the Texas crude oil in-

to Mexico. Gasoline is exceptionally high in Mexico, and due to peculiar government requirements or restrictions, the oil has been placed in small tin cans holding about 10 gallons each and these cans are shipped into the interior on the backs of burros. Frequently the jar and jolting of the can will damage it severely so by the time it has reached the end of its destination the gasoline, which of course is very light and volatile, will have evaporated and an empty can will be delivered after a long and delayed journey. In the case of the crude oil it is much heaver and not volatile to any extent, and due to its difference will probably not be under the same restrictions as gasoline, and on account of its very low first cost, it can be delivered to remote points at a great deal lower figure than the price now paid for gasoline, which has always been shipped from the States.

When the arrangements for the delivering of oil and the problem of irrigating is looked into more carefully in Mexico, it would seem as though that country must be greatly improved and the valuation of land increased, therefore irrigating is one of the greatest assistances to a country for increasing its valuation and raising the quality of its products.

THE MAN YOU CAN HELP.

There are plenty of men who will grasp your hand,
With a pleasant cordial smile;
There are plenty of men who will pass you by
In the most indifferent style.
You may be "cut" sometimes by those
Whom in boyhood days you knew;
But a man will always treat you well
When he wants a favor from you.

How glad is he that you look so well;
And how do your children do?
Your wife is in good health, he trusts,
And your business prospering too.
He struck a new brand of cigars today—
By the way, just try a few!—
Oh, yes, a man will treat you well
When he wants a favor from you.

When the favor's done—alas! alas!
How suddenly he forgets
How he loved you when he needed, perhaps,
Your help to pay his debts;
But the fact remains, and every one knows,
That this assertion's true;
A man will always treat you well
When he wants a favor from you.

--Somerville Journal.

CORRESPONDENCE.

Greeley, Colo., Sept. 8th, 1902.

Editor Irrigation Age.

The season of irrigation has been very dry here—the dryest season known for years, in fact. There has been no moisture to speak of for twelve months. The potato crop, which is the main crop, has fallen off at least 30 per cent from the corresponding time last year, the whole crop being raised and grown by water in storage reservoirs. Water has run up to a fabulous price, ranging from $10 to $22 per day for a water right, which is 32 statute inches issued over weirs at canal.

Sugar beets, which are being grown to supply the sugar factories of Loveland, Greeley and Eaton are doing very nicely, considering the extremely dry weather. The two years' expèrience the farmers have had in beet raising in this locality, leads me to believe that more beets will be put in next year than potatoes. Beets have nearly crowded wheat from a place on the farm, as for years we have been compelled to sell wheat under a millers' combination price, which has been, when possible, a starvation price. The advantage beets have over grain is that they have a fixed value of $4.50 and $5.00 per ton delivered.

Farms are raising in values daily, varying in price, according to location and water facilities, from eight to twelve thousand dollars for eightyac es.

John G. Hall.

NATIONAL IRRIGATION CONGRESS

AND CONVENTION OF THE

AMERICAN FORESTRY ASSOCIATION

COLORADO SPRINGS, OCTOBER 6th to 9th, 1902.

Colorado Springs, September, 1902.

Dear Sir:

On behalf of the officers and committee of the National Irrigation congress, Chamber of Commerce and City of Colorado Springs, we take pleasure in inviting you to attend the Tenth National Irrigation congress to be held at Colorado Springs, October 6th to 9th, 1902.

The National Irrigation Act is of great importance to the entire country, and it is the desire of all concerned to make the Colorado Springs congress a great meeting of all who are enthusiastic for the development of the "Greater West."

Gilbert McClurg.

For the officers and committees of the National Irrigation Congress.

D. B. Fairley.

President Colorado Springs Chamber of Commerce.

J. R. Robinson.

Mayor of Colorado Springs.

Socorro, N. M., Sept. 2, 1902.

EDITOR IRRIGATION AGE, Chicago, Ill.

Dear Sir:—I have received copies of THE IRRIGATION AGE of August, and am getting interested in the grand work.

I have in view the establishment of irrigation plants in several communities in this valley, where the natives cultivate small holdings, clustered together, which they irrigate from common ditches, drawing the water supply from the Rio Grande river. This river goes dry now every year in June, thus causing the loss of two thirds of these crops. There is plenty of water within a few feet under the surface of the river bottoms, which could be pumped and raised from 25 to 75 feet, thus increasing the acreage of the planting up to the foot hills, where the best lands now are, besides furnishing sufficient water for the actual acreage now in cultivation.

For that purpose I am now agitating and promoting the enterprise, getting the people together to discuss the plan of cooperation in the scheme.

I have read pages 278–279, August IRRIGATION AGE about electric pumping plants, with interest, but as there is no power generated here, the scheme could not perhaps be adopted. What is needed here would be the establishment of a plant economical in original cost, and in maintenance, capable of furnishing and elevating water from 25 to 50 feet, in quantities of 500 to 1000 gallons per minute, to fill the ditches when the river supply gives out, and to remain idle while the river furnishes the water.

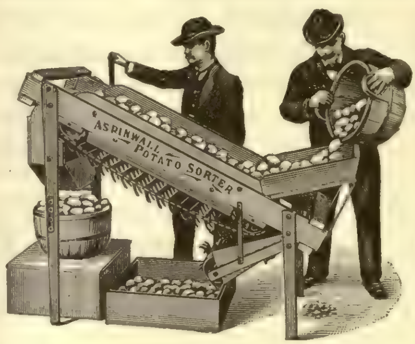
Now, could you place me in correspondence with some reliable firm who not only manufactures such plants, but who would give me the necessary information and data so that I could talk intelligently with the people out here with benefit to themselves?

Yours truly,

P. A. MARCELLINO.

THE ASPINWALL POTATO SORTER.

We illustrate herewith the new Aspinwall potato sorter, which received a silver medal at Trondjhem, Norway, and also a bronze medal at the Charleston (S. C.) exposition. The machine is a new departure in potato sorters, using an elevator with long distance travel, which enables very rapid sorting combined with excellent work. In the construction another



admirable feature is gained in having the hopper down low, making easy work in shoveling and feeding the machine. The entire work is under control of the operator, any potatoes which are decayed or ill-shaped may be removed while the work is progressing; there is no bruising or injuring the potatoes in the least. The capacity of the machine is upwards of 2000 bushels per day. The Aspinwall Manufacturing Co., Jackson, Mich., are the makers.

AGRICULTURE.

HOME MIXED FERTILIZERS.

E. E. Burwell in the American Fertilizer: Having read the "Talks With Farmers" in your May number, I would like to say a few words in regard to fertilizers.

It has been a general opinion among farmers that fertilizers exhaust the soil, and many still believe this to be a fact, especially the old-time farmers: They think a fertilizer is all right to start the crop, but is very exhausting to the soil.

To experiment for my own belief and satisfaction, I selected a piece of high partly gravelly and clay soil. The land had no manure for several years before I began the experiment. I used fertilizer on this land every season for eight years, giving it rather light applications, no more than I thought the crop would actually need. I found it improved every season, and after eight years was in much better condition than when I first began. The ninth year I sowed wheat, and it was extra nice; and this year sowed wheat again without any fertilizer whatever, and it now looks even better than last year.

During these ten years I used no manure whatever, plowed in no green manure and for eight years no stubble or humus of any kind, though I applied air-slacked lime every fourth year and harrowed it in. Fertilizer will not exhaust the soil if used intelligently.

Now, there is another question that has been stirring the minds of the farmers, and that is "home mixing." Does it pay? Can we not save something by buying materials and mixing them ourselves? To this I will say that if a man thoroughly understands the business of manufacturing fertilizers, and uses five to ten carloads every season, it would pay him to have a room fitted up with mixers and grinders and prepare his own formulas, but for the average farmer to undertake to make a few tons of fertilizer each season by mixing up acid phosphate, muriate of potash and nitrate of soda, for all crops and all purposes, with a shovel, and deceiving himself with thinking that he has got a high-grade fertilizer for less money than the manufactured article would cost, is not only deceiving himself, but is really paying more for the plant food he gets than he would for a high-grade ready-mixed fertilizer. Nitrate of soda, muriate of potash and acid phosphate make a complete fertilizer, but do not form a high-grade fertilizer when mixed. It requires some intelligence and skill to use fertilizers to obtain paying results, and requires more to make them perfectly than to use them. Making one's fertilizers at a saving is about like the farmer building his own barn or home. He can get the material already prepared, and if he has experience in that kind of work, has good tools, and knows how to use them, he might save something in labor by doing it himself; but if not, let some one do it that knows how.

Fertilizers pay when made and used intelligently. I should as soon think of gardening without first-class seeds as without high-grade fertilizers.

WHITE DUTCH CLOVER.

One of the most valuable plants for the general farm is the little clover known as White Dutch. It comes on very early in the spring and continues to make good feed late in the fall. Eor general grazing of sheep, cattle and milch cows it has no superior in the clover family. As a bee food there is nothing equal to the white blossoms, and honey made from this clover, always commands the very highest

market prices. It is valuable for sowing on lands subject to washing, as it holds the soil and keeps a turf of vegetation, where otherwise there would be a gully.

The white clover is known among the students of agriculture, as trifolium repens, and is scattered over almost the entire farming sections of our country. It forms a nice lawn when mixed with blue grass, and may be mown and fed to hogs and poultry, with much profit. In some sections of the west, where natural vegetation is scant, this clover forms the chief food for hogs, cattle and poultry, kept in pens throughout the summer months. It can be cut several times in a season, and is fed green. Several farm animals may be kept in good condition by the green feed taken from the lawn orchard and other patches of the white clover. In this respect it probably excels all other legumes.

White clover will grow on any soil suited to the ordinary clovers, and often makes good crops on hard clay and wet marshy lands, where other plants fail. Like all others legumes it gets sufficient nitrogen from the atmosphere, but must be supplied with abundance of potash and phosphoric acid. These plant foods, when judiciously applied, will cause the clover to make a perfect mass, covering every spot with rank growth and luxuriant foliage, where spots may be left in seeding to others clovers. A fertilizer containing at least 8 per cent potash and a similar amount of phosphoric acid, should be applied in the spring, at the rate of 600 to 1,000 pounds per acre. Another good mixture for clover would be about 300 to 400 lbs. acid phosphate and 150 to 200 lbs. muriate of potash. These can be thoroughly mixed with the soil before seeding.

Soil for white clover should be thoroughly prepared before seeding and the weeds killed out, as much as possible. The seed is very small and the plants are easily choked out until they reach a size so that they can spread over the ground. Some successful growers of white clover recommend sowing it alone, in the spring, while others sow it at any time, and mix blue grass with the seed. For lawns this is advisable and adds to its beauty. If sown for permanent meadows, or pastures, a mixture of other clovers is the best plan. In this way the early white comes in and gives feed while the others are growing, then in the fall when the other clovers are dead the white springs up for winter pasture.

White clover weighs 60 pounds to the bushel of clean seed, and is much smaller than the other clovers. If the soil is in good condition, and the season favorable, eight pounds will be sufficient seed for an acre. When mixed with the general clovers for meadows ten pounds is the proper amount to sow. The seed may be had from any dealer at about 20 cents a pound. If the plant shows signs of giving out it may be plowed up and resown, thereby giving the land the benefit of the foods collected by the leaves and roots. It will assist wonderfully in renovating old soils and holding the plant food from washing away. Those who have been prejudiced against this little plant should give it a trial.

JOEL SHOEMAKER.

GROWTH OF BEET SUGAR.

C. F. Saylor, the special agent in charge of the beet-sugar investigations of the Department of Agriculture, is in Washington, making his annual report. He gave out the following figures regarding the industry during the last year:

The total production of beet-sugar duties in the season 1901-2 has aggregated 185,000 tons, an increase of 140 per cent from the 77,000 tons produced during the season 1900-1. There were thirty-one factories in operation in 1900, according to the census figures, and eleven more were started in 1901.

There are nine factories in course of construction for operation in 1902, as follows: Sebewaing, Carrollton, Mount Clemens and Crosswell, Mich.; Shelby, Ind.; Greely, Eaton and Fort Collins, Col., and Phoenix, Ariz., ranging in capacity of daily output from 500 tons to 1,000, the latter figure being the capacity at the Phoenix plant.

Other companies have been organized with a total capitalization of $49,000,000, and would require annually a working capital in addition of $9,080,000. According to Special Agent Saylor, they would purchase from the farmer annually beets to the amount of $14,700,000, besides many other crude materials.

The number and aggregate capital of these prospective plants, by states, include the following: Arizona, two, $1,500,000; California, five, $3,500,000; Colorado, seven, $5,000,000; Indiana, one, $1,000,000; Iowa, six, $3,100,000; Idaho, one, $500,000; Michigan, twenty-eight, $14,900,000; Montana, one, $500,000; North Dakota, two, $1,000,000; Oregon, one, $500,000; South Dakota, two, $1,000,000; Utah, three, $2,500,000; Wisconsin, ten, $3,150,000; Wyoming, two, $1,500,000.

IRRIGATION.

IRRIGATION IN IDAHO.

Prof. Elwood Mead, expert in charge of irrigation investigation for the department of agriculture, writes encouraging letters to State Engineer Ross regarding the future of irrigation work in Idaho. Mr. Ross is a personal friend of Prof. Mead and the Washington expert is kindly disposed toward Idaho and its great future as an irrigation state. Prof. Mead has so expressed himself in numerous letters. Prof. J. D. Stannard, one of Prof. Mead's most accomplished assistants, is now working under the direction of State Engineer Ross in the Big Lost River valley, says the Boise (Idaho) Statesman.

The name of "Big Lost River Valley" does not sound as though there would be much water to irrigate with, but State Engineer Ross says it is a productive country. The river gets lost all right; and it is lost several times throughout its course. At one place for a distance of eight miles it disappears entirely, only to reappear again as the impervious strata approach the surface.

The valley of Big Lost River is long and narrow, but the soil is of great richness. It is the object of the present inquiry to determine upon the cost of building a storage reservoir that will hold the water of Big Lost river not far from its source. The fact that the river sinks into the substrata of gravel will make no difference. The engineering problem does not deal with the temporary disappearance of the water, but the holding of it in reserve. It will be allowed to run in its natural channel, as the loss from percolation or absorption is only slight. As a matter of fact, the evaporation is reduced to a minimum while the stream is below the surface.

These problems are now engaging the attention of Prof. Stannard in his work. The town of Mackay is in the center of the Big Lost river irrigation district, and the people of that section are wide awake to the proposed storage-reservoir enterprise. They have an active organization among the irrigators and have raised money to help along the project. The people are students of the great problem and have encouraged State Engineer Ross to aid them in storing water.—*Ex.*

IRRIGATION BY WELLS.

An argument in favor of irrigation by wells is found in the following article

which recently appeared in a califorina exchange:

"We all remember what good old Ike Walton said of the strawberry:

"Doubtless God might have made a better berry, but doubtless God never did.

"So I say, that God might have made a richer and more productive country than Ventura, (Califorina) but doubtless God never did. Yet rich and excellent as is Ventura county, she has one signal lack, a scarcity of water.

"In these late years of slight rainfall, I think it is not exaggeration to state that with ample water for all needed irrigation, the productiveness of the country might have been nearly doubled. Yet it is believed by some of the wisest that this want hangs wholly upon lack of development. As in Los Angeles and San Bernardino counties, there is a vast reservoir of the purest water under Ventura's rich acres that only needs tapping to yield an unlimited supply of the very best water.

"One of Oxnard,s most wide-awake young farmers, Mr. A. F. Maulhardt, has proved this true in the region about Oxnard, California, His several wells, some of which are flowing, from which are being pumped hundreds of inches of excellent water, are proving a bonanza to him and as an object lesson of what pluck and enterprise may do, will come with blessing to all his neighbors. Already his example has proved contagious and more than one of his neighbors have sunk the shaft that has won this greatest desideratum of Southern California agriculture.

"As one rides along the road between his irrigated fields of beans and beets, and those of his neighbors that have not had the benefit of the irrigation, the advantage is so marked that it must be most convincing to all interested in the production of maximum harvests.

"All that the great agricultural region from Piru to Ventura needs to make it the very garden of the world is a generous supply of water. That nerve and enterprise may secure this by wisely located wells almost goes without saying. Surely it is a matter of greatest moment to this magnificent county."

WATER REQUIRED IN IRRIGATION.

Facts of interest in connection with the amount of water used in western irrigation are furnished by a description of the Vernal Valley irrigating system of northeastern Utah, now in preparation for one of the reports of the United States Geological Survey. The Vernal Valley is a fertile region, approximately 20 miles long by 3 miles wide, its boundaries being sharply defined by the surrounding foothills. The soil is a sandy loam and the principal crops are alfalfa and oats. Like many other sections of the west, the mean annual precipitation in the Vernal Valley is small, being only a little over 9 inches, an amount entirely insufficient for agricultural purposes; furthermore, the annual snowfall is light and there is no well defined rainy season. Hence, without the use of water, the land is practically worthless for cultivation, its value being placed at $1.25 per acre. With the construction of irrigating ditches, however, and with the assurance of a good water supply, the same land at once increases in value to $30 an acre.

According to the twelfth census, 25,000 acres of the Vernal Valley are under ditch, 17,471 acres of which were being cultivated in 1900 by means of irrigation, the population numbering 6000. All the water which is diverted for use upon the land is taken from Ashley creek, a tributary of the Gree river. From this stream there are three main canals, besides a number of smaller ones, each drawing a specified amount of water which has been allotted by law.

Measurements have been made at various times, by the hydrographers of the United States Geological Survey, of

the amount of water appropriated by the canals and used upon the land. The combined maximum capacity of the canals of the valley was found to be sufficient to allow 350 cubic feet of water to pass in each second of time. The records of the flow of Ashley creek and of the various irrigating canals, during the season of 1900, show that 48,355 acre-feet, approximately, were used upon 17,471 acres, the area irrigated that year, which would be equivalent to an average depth of 2.8 feet of water over each acre. The discharge of 48,355 acre-feet as noted above, for the six irrigating months, represents a mean flow of 133 cubic feet per second, or expressed in other terms, the duty of water in the Vernal Valley was 1 second foot in 131 acres.—Redlands, (Cal.) Citrograph.

BRUSH DAM TO GO.

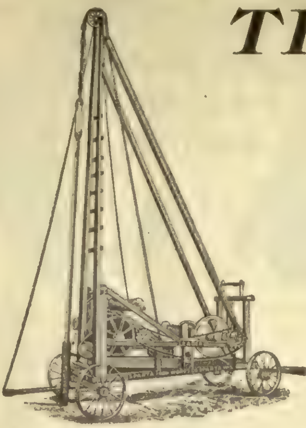
A notable improvement in Kings county, Cal. is about to be made, according to the *Fresno* (Cal.) *Republican*, all the necessary plans and financial arrangements having been completed. The old brush dam of the Peoples' Ditch company is to be done away with and its place is to be taken by a modern structure that will improve the fall of the canal and will result in a considerable saving to the company's annual expense account.

The Peoples' canal has its head on the south side of Kings river, some 500 feet above the head of Cole's slough. The diversion of the water from the river to the canal is at the present time brought about by the old brush dam referred to, but this dam has cost the corporation from $4000 to $6000 a year for repairs—say 60 per cent of the total expenses of management and maintenance. It was time to change this condition of affairs and the company accordingly has had plans drawn and has ordered the material.

The brush dam stands about half a mile down stream from the railway bridge below Kingsburg. The new dam will be built 300 feet below the present site. The bottom is said to have been found to be quicksand, but all the difficulties incident to this sort of base have been overcome in in advance, so to speak, and nothing remains but to begin construction, which will be commenced at once.

The new dam will be 450 feet outside of the wings. It will be eighteen feet high and will have a thirty foot base. It will be constructed under the direction of I Teilman, civil engineer of Fresno, whose plans have been adopted. 300,000 feet of lumber will be used in the structure. The total cost will be $20,000.

The Peoples' canal was started in 1873 and an area of 25,000 acres is irrigated by the main ditch and its branches. It has had its share of litigation, like every other ditch company in the San Joaquin valley, but everything of that kind seems to have been settled with more of less ease since the Supreme court confirmed the judgment in its favor in the big contest in which the Laguna de Tache people sought to prevent it from taking water from the river at all.



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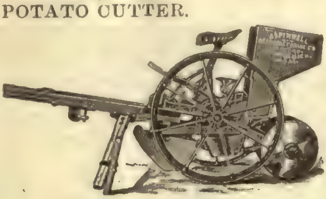

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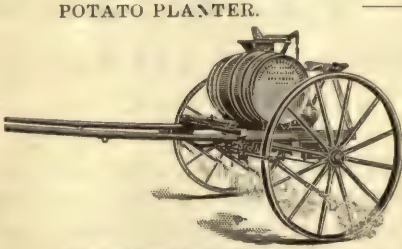

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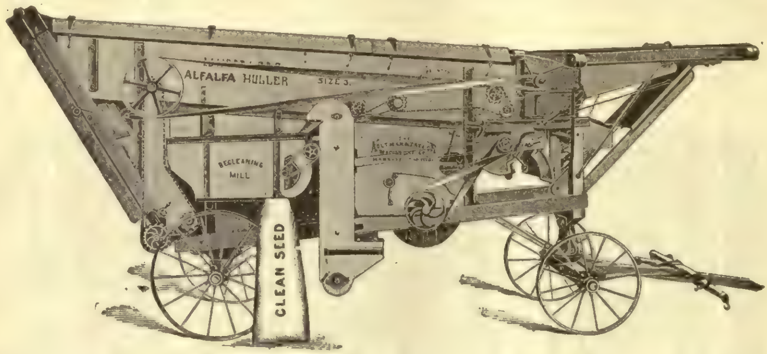

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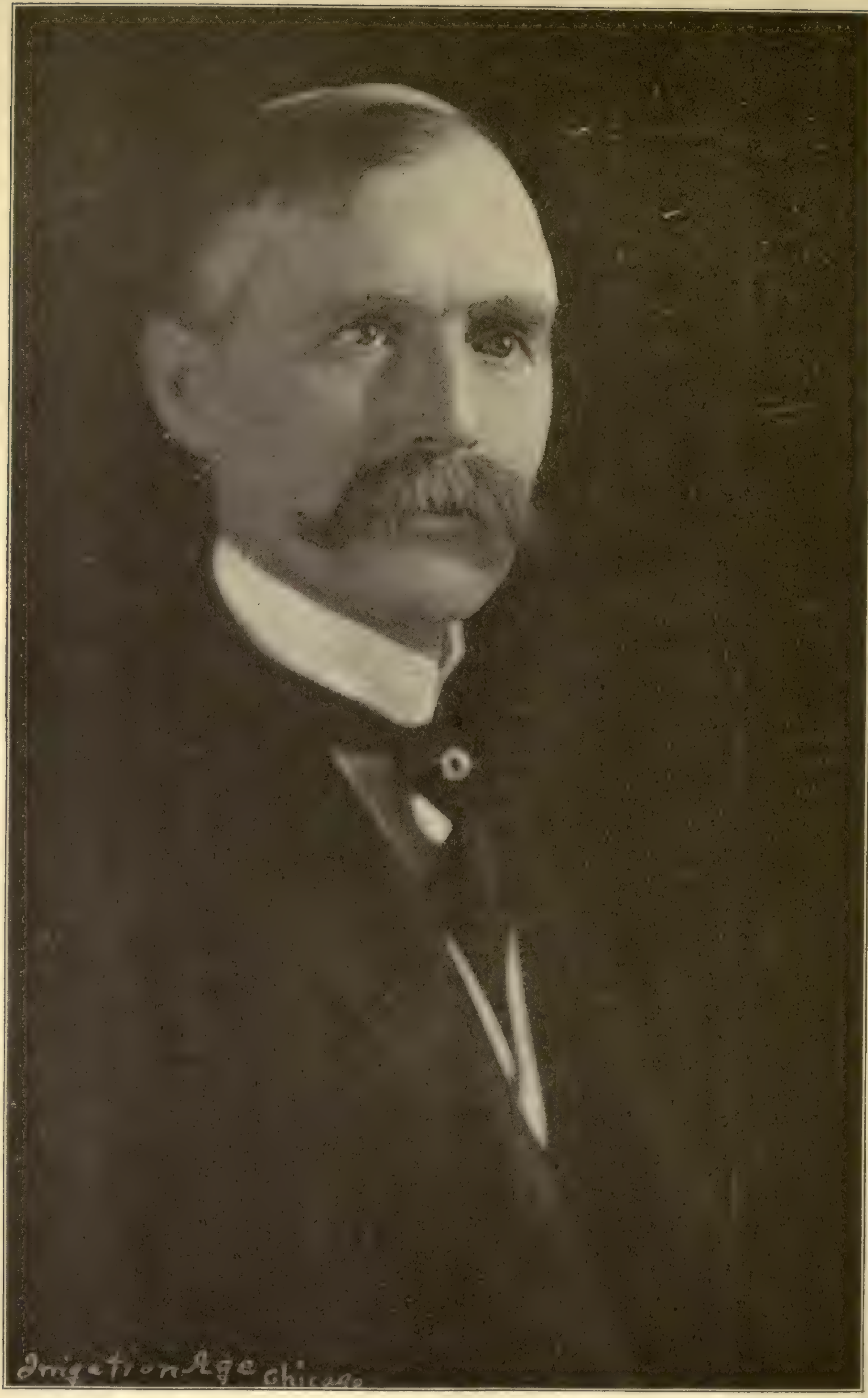

HON. THOMAS F. WALSH, Ex-President Tenth National Irrigation Congress.

THE IRRIGATION AGE.

VOL. XVII. CHICAGO, OCTOBER, 1902. NO. 10

Hon. Thomas F. Walsh. In presenting to our readers the splendid speech of Hon Thos. F. Walsh, delivered at the opening of the Tenth National Irrigation Congress, of which he was president; it is considered appropriate to present a portrait of that gentleman and we are therefore using a very excellent likeness of him as our frontispiece in this issue. In view of the splendid work done for irrigation by Mr. Walsh, little of which will probably ever be known even by the friends of that industry, it is only fitting to say at this time, when he is stepping down and out of office, that a more devoted friend to the cause will rarely if ever be found.

Mr. Walsh is the embodiment of all that goes to make a gentleman; has led a remarkably clean life and has withall been emminently successful in his business affairs, being now rated among the strongest financial men of this age.

Mr. Walsh is a mine owner and mining engineer. He was born in Tipperary, Ireland in 1851, and educated in the public schools, afterward learning the trade of mill-wright. He emigrated to the United States at the age of nineteen, settling in Colorado. He then engaged in mining, making a close study of geology, mineralogy, metallurgy and the deposition of ore bodies and the development and treatment of ores, and was also instrumental in introducing new methods of treatment.

He developed, equipped and is now sole owner and operator of the Camp Bird mines, of Ouray, Colorado.

Mr. Walsh was one of the National Commissioners to the Paris Exposition in 1900, and a member of the A. A. A. S., Washington Acadamy Scineces, Nat'l Geo- Soc., Am. Soc. Mining Eng'rs., Ex-president National Irrigation Congress, etc.

He is also a member of a number of clubs, among them being the Denver Club and the Cosmos Club, Washington.

Mr. Walsh is an extensive traveler and has been lavishly entertained abroad, but only as a public spirited American. He has hosts of friends in all countries.

Our Report of the Congress. We make no excuse nor apology for allowing our report of the Tenth Irrigation Congress, to monopolize this number of the AGE to the comparative exclusion of our regular departments. Our only regret is that, owing to the fact that the journal goes to press so shortly after the meeting was held, lack of time, as well as lack of space, prevents our giving all of the excellent addresses, which were delivered at Colorado Springs. We give in this issue, that of the ex-president of the association, Hon. Thos. F. Walsh, on "the Humanitarian Aspect of National Irrigation," and will later present other addresses in the order that their importance warrants.

The Irrigation Congress is the event of the year, to friends of this great movement and this year it was of even more than usual interest, as it was, in a measure, a celebration of the recent victory achieved for the cause in the passage of the irrigation act. It is to be regretted that

the harmony of the meeting should have been disturbed by a discussion of matters of minor importance, and that earnest men, whose time has been spent in this great work, should have been, to a certain extent, put in the back-ground, while the fore-part of the stage was occupied by one whose chief bid for consideration was his fluent speech and ready tongue, rather then any direct work done for the good of the cause.

IF THIS BE TREASON MAKE THE MOST OF IT.

If, in the blood of the Martyrs be found the seed of the Church, then in the slaughter of the proposition to amalgamate the Irrigation Congress with the Trans-"Mississippi," will be found the inevitable perpetuation of the former body as an independent and national organization. Shoulder to shoulder, sparing no effort, neglecting no precaution, will the opponents of the merger now feel it incumbent upon them to prove the strength and consistency of their position. They have builded better than they knew, and in the next session of the Congress at Ogden will be seen the wisdom of their policy.

The enemies of irrigation—men of the east, who regard the Irrigation Act as one of sectional favoritism; an effort to benefit the west at the expense of the east—will watch eagerly for an opportunity to exclain "I told you so," and it is hoped the appropriation made by congress will be so judiciously expended, as to give the enemies of the cause no chance to cavil. It is of great moment that no suspicion of personal gain should be connected with the work. The reservoir sites should be carefully selected and where they would be of the most immediate use, not where it would be most advantageous for any syndicate or co-operation to have them. By the time another year rolls around, and we have occasion to chronicle another irrigation congress, may we also be able to chronicle great achievements, and may the work done justify the hopes of its friends.

For November. In our November issue of this Journal we will present to our readers an article written especially for the IRRIGATION AGE, by Edwyn H. Pargiter, of Delhi, India. Mr. Pargiter, is prominent in irrigation work, in his Majesty's service in India and his wide experience and thorough knowledge of the subject, will make this contribution from his pen of unusual interest and value. His recent visit to this country familiarized him with the system of irrigation in use here. We will publish his portrait in connection with the article.

Lute Wilcox in Denver Field and Farm. George H. Maxwell, who had presumedthe prerogative of running things in the National Irrigation Congress, was so completely squelched at Colorado Springs last week that he ought to sneak off and lose himself for all time to come. He tried to hamstring the congress by merging it into some trans-Mississippi organization in which the irrigationists had no interest

whatever and failing in this he tried to belittle the work of Elwood Mead, but was roasted by everybody to a dark brown finish.—Denver Field and Farm.

Geo. H. Maxwell Et al. The IRRIGATION AGE has recently been brought into contact with some of the men, who claim the credit of having secured legislation by Congress extending aid in the construction of irrigation works. Through conversation with those men we have become acquainted with some of the more active spirits, and have discovered why they should be active and what will be the probable outcome of national irrigation, if the work continues to be manipulated as it is at present. We believe our understanding of the situation is correct, if not, we shall be glad at any time to receive suggestions or criticisms. We regard national aid in irrigation to be essential to the development of any arid country. If the needs of the west had been fairly considered in the legislative halls of our government fifty years ago or if the people of the east had understood the conditions existing west of the Missouri, we believe funds would have been forth-coming from the National treasury, when the home-steader first ventured beyond the limits of the region enjoying ample rain-fall. The struggle for a livelihood, which confronted the western pioneer would, under such conditions, compare favorably with the hardships, which were faced by the early settlers of the more humid eastern states. As it is, our western farmers have been compelled to fight their battles single-handed. They have had but little protection from the states or the government, when the water supply has become short. As a last recourse they have usually been compelled to resort to the courts, and have spent much more in an attempt to protect their rights than in the construction of irrigation works, for diverting water from the streams and distributing it over their farms. The government has furnished them title for their land, but water, and not land, is the valuable thing in an arid country. Transfer the water from one tract to another and land values fluctuate accordingly.

Wise men from the East who could have made themselves acquainted with irrigation in foreign countries, became the legal advisers who conducted these suits and have taken from the farmer a large part of the profits of his farm. Nearly all the principles of irrigation law, which are recognized in older irrigated countries where water users are protected, have been disregarded. The legal lights, profiting from this kind of litigation, were not slow to see what a field was opening before them. They have used their influence to block reform in irrigation law in our state legislatures, fearing that the farmer, under more favorable conditions, would no longer contribute to their income.

This was the situation when a new legal light appeared on the scene. Not a great many years ago, a young man named George H. Maxwell was clerk of the court in Oakland, Cal. He studied law there, and was admitted to the bar. The irrigation lawyer in California holds an enviable position as far as personal pecuniary advantages are concerned. But few irrigated states fall further from their duty of protecting the irrigator than does California. Mr. Maxwell saw his opportunity and without attempting to reform state laws or aid the irrigator, he became the representative of large interests which, through poor laws badly administered, were able to secure a monopoly of the water of a number of streams of the state. While representing one of these companies, it happened that it would be an advantage to the corporation if the Wright act could be repealed. The constitutionality of the act was therefore questioned and the case finally came before the United States Supreme Court, where Mr. Maxwell represented his employers in court. The suit

was lost and the Wright act still stands on the statutes of California.

In the meantime, so we are told, the Southern Pacific Railway and other corporate interests have employed Mr. Maxwell, and he was delegated by them to attend the session of the irrigation congress and similar bodies, and further the move for national aid. Soon the other trans-continental roads joined and Mr. Maxwell established a society, known as the National Irrigation Association, which has no policy except such as he may dictate. Its principle object is to furnish revenue. This is raised by annual dues amounting to $5 per member. The total receipts have exceeded $15,000 in one year; which it is claimed by those in a position to know, is at Mr. Maxwell's disposal. The trans-continental railways furnish him $30,000 per year. With this financial backing Mr. Maxwell has entrenched himself first, as the representative of the poor neglected farmer, and the would-be irrigator from the over-crowded city, and second, since the passage of the Irrigation Act, as the mouth-piece of Uncle Sam. This latter assumption on his part is only possible through the consent of the servants of the government, who have in charge the administration of the provisions of the recent act of congress.

Mr. Maxwell has attended many congresses and conventions, where he has generally managed to dictate the character of the resolutions adopted. He is aided in this work by men whom he employs directly, and by employees of the corporate interests, which furnish him with funds. It is interesting to the outsider to observe the manner in which Mr. Maxwell and his men try to handle an irrigation congress or similar convention. In the first place, Mr. Maxwell and a large number of his confidential men secure places on the committee on resolutions or any other committee of importance. As soon as the committees meet, Mr. Maxwell sees that sub-committees are appointed, and that he is on the sub-committee which has charge of the work he desires to see carried through. The reader can satisfy himself as to the personel of many of these committees by examining the records of the session of any irrigation congress, during the past three years. Many of the men employed by Mr. Maxwell, spend a large part of their time securing members for the National Irrigation Association.

It should not be understood however, that the rank and file of the National Irrigation Association, are of the type represented by Mr. Maxwell and four or five of his followers. On the contrary, the membership is made up of many of the leading thinkers and public men of the west, whose only object in joining the association was to further the interests of irrigation.

Mr. Maxwell has always opposed reform in state irrigation laws. The childish objection he made to such a movement at the irrigation congress recently held in Colorado Springs, was that the recent act of congress would make water so plentiful that every body would have enough and the fundamental cause of litigation would be destroyed. With no knowledge of engineering or the duties of an engineer, he has uniformly opposed giving engineers authority when water is to be divided or laws are to be administered. Engineers have charge of this work, wherever irrigation has achieved the greatest development. In the older irrigated countries, where the governments build irrigation works out-right, not expecting any money return from the farmer, the engineers not only administer the laws, but frame the necessary measures for bringing about reform in the laws. A knowledge of irrigation engineering and an appreciation of the essentials of irrigation law, is what Mr. Maxwell needs before he will be a safe exponent of the policy of the government,

in the important reclamation work upon which we have just entered.

In justice to Mr. Maxwell, we will say that he is a good talker, and has a manner that is winning. Without those requisites he would not have represented so many large corporate interests for the past three or four years. We say further that it is a credit to the railroads to employ men, who can educate the people in irrigation matters, who can talk intelligently with the leading men of the country, and aid in the adoption of such national policies, as will build up the country to which the transportation lines may be tributary. The question is, do the railways gain anything by employing agents who antagonize those who have been, and are yet working for the development of the arid west? Does it aid the railroads to secure the services of persons to go from one legislature to another, for the purpose of defeating reform legislation in irrigation matters? Would it not be better for the railways, as well as for the government service, if the agents employed by the transportation lines, should advise with, instead of dictate to, the engineers actually in charge of the reclamation work? To a disinterested person, it seems that the authority which Mr. Maxwell has assumed will sooner or later discredit the work of national reclamation from which the West hopes much.

Large Irrigation Fund in Sight. Irrigation enthusiasts will be gratified to learn that there is $7,772,733 to be applied on the semi-nrid regions of the West to make them blossom. The fund represents the net proceeds from the sale of public lnnds in the semi-arid states during the last two fiscal years, which, under the law, can be applied to the promotion of the national irrigation project.

Never. The IRRIGATION AGE has never seen anything to compare with the effrontery with which Mr. Geo. H. Maxwell attempted to control everything conneeted with the Irrigation congress.

How's This? If the National Irrigation Association was formed to act as business agent for the National Irrigation Congress, and if this assoeiation has, as its principal—in fact so far as any one has been able to learn its only representative, Mr. Maxwell—stated on the floor of the Tenth Congress, a membership of over 2,300, who pay from $5 per annum upward to $100, why then is it necessary to write immediately after adjournment of the congress calling for $10 and $20 from delegates to help pay for publishing proceedings and photographs. The IRRIGATION AGE has already invested $100 in half tones and engravings illustrative of the eongress, and if those interested will follow its columns during the next few months, a fairly comprehensive report of the proceedings may be obtained without paying out the above amount.

'THE TENTH IRRIGATION CONGRESS.

A NOTABLE AND IMPORTANT MEETING.

The Tenth National Irrigation Congress, which convened in the auditorium of the Antlers Hotel, Colorado Springs, Colo., Monday, October 6th, was in every way a notable and important meeting. It was particularly notable for its large attendence and the broad humanitarian sentiments expressed by the leaders in their opening speeches. The number of delegates in attendance was 325, which was larger than that of any congress heretofore held. Another interesting feature of the congress was the large number of prominent men in attendance from different sections of the country, including Hon. Thos. F. Walsh, of Washington, D. C., president of the Irrigation Congress, Senators Teller and Patterson of Colorado, Senator Carey, of Wyoming, and others of equal importance.

As stated above there was a broad humanitarian sentiment, expressed in all the speeches which were far away from a commercial view of the movement.

During the early part of the proceedings a message of greeting was received from President Roosevelt.

The principal speaker of the opening day was Hon. Thos. F. Walsh, who in describing the benefits to be derived from national aid, stated that he was thinking of the family as a unit; father and mother and little children now confined within the narrow limits of city life, how their horizon would be broadened and enriched by the transition from paved streets and crowded tenements out under the blue sky and in the pure air that westerners love so well.

Mr. Walsh stated that it is not the dream of empire which may come to a great nation wherein 100,000,000 will some time dwell, but it is the dream of home and independence, which will come to many a struggling family with the announcement that other fair valleys have been thrown open to settlement at the actual cost of reclamation.

In discussing the humanitarian features of irrigation, of how the reclamation of arid land would improve the conditions of the poorer people by opening up new channels of industry for them, Mr. Walsh suggested that great good could be accomplished by philanthropists if they would use their money in assisting poor people to secure a start on a small irrigated farm. Mr. Walsh's speech is printed in full elsewhere in this issue.

Considerable strife was noticable among delegates from different

Group Photo of Delegates to Tenth National Irrigation Congress, Colorado Springs, Colo.

localities as to the proper points at which to expend the money now available for reservoir constructions.

Arizona, Idaho, Colorado, Washington, and other states and territories, represented by delegations urged their claims to early attention on the congress, with a view to influence government action in their direction.

It is the general opinion, however, that the railway companies, who were well represented in the congress, will bring their influence to bear to the end that early appropriations may be expended where the greatest good may come to the greatest number. The sentiment seemed to be that special caution should be used in the handling of the earlier expeditures.

The United States government was represented by a goodly number of experts in irrigation, notable among them being Dr. F. H. Newell, chief hydrographer of the United States geological survey, and Prof. Elwood Mead, chief in charge of irrigation investigations. Illinois had only two representatives, out of twenty appointed by Gov. Yates. If the manufacturers of agricultural implements throughout the central states understood what this congress means to them they would all have been represented.

During the second day's session agitation bearing toward the uniting of the Trans-Mississippi, the irrigation and the mining congresses was started, it being started, by those in favor of this move, that there were so many meetings called, of a similar character, that it was not only inconvenient but expensive to attend them all. This movement was suggested by one of the prominent delegates, who very advoutly shifted it to the shoulders of Geo. H. Maxwell, thinking that the latter's influence would be highly beneficial. This, however, proved to be wrong, as when the votes on the final out-come were counted, it was shown that the matter would better have been left alone.

The attendance on Tuesday was larger than on Monday. Many delegates arrived from Colorado and other western states, and the spacious auditorium was found none too large to accommodate the meeting.

One of the things particularly noticable, in this congress, was the great representation of business men; managers of large corporations, and men of affairs generally Among these were E. F. Blaine, of Seattle, Wash., who is manager of the largest irrigating system in his state; Senator Carey, president of the largest irrigating system in Wyoming; and J. D. O'Donnell, head of the largest system in Montana. There were in attendance also, all of the state engineers of irrigation, among them being, Frederick Bond, of Wyoming; Adna Dobson, of Nebraska; J. A. McCune, of Colorado; A. F. Doremus, of Utah, and D. W. Ross, of Idaho.

United States Senator Dietrich, Nebraska, made a speech before the congress, in which he touched on two issues, which were before congress last winter—viz.: Irrigation and beet sugar. He expressed the opinion that the arid country would be the great sugar producing section of the United States.

Among the other addresses of Tuesday, which were favorably commented upon was that of President Slocum, of Colorado college. He dwelt on the relationship of irrigation and good citizenship and emphasized the fact, that the irrigation farmer must, of necessity, be a fairly well educated man, because he has to deal with complex questions relating to the ownership and divisions of streams on which he has to depend for his water supply.

The only address of the congress delivered by a woman was given on Tuesday morning by Mrs. Gilbert McClurg, of Colorado, who responding for Mrs. Denison, president of the general federation of womans's clubs, gave greetings. Mrs. McClurg said, referring to the meeting of the general federation of women's clubs in Los Angeles last May:

Utah Delegation Tenth Irrigation Congress.

"The Colorado women, later joined by those of California, introduced at the bi-ennial convention of women's clubs at Los Angeles, a resolution indorsing and requesting government aid for irrigation. This resolution was adopted unanimously. When I first broached the proposed resolution in the committee room, one woman demurred, saying politics had no place in the federation of women's clubs. Mrs. Sarah Platt Decker rejoined, 'Irrigation is not politics. In the west it is religion.' "

On Tuesday evening Clarence Johnson, of Wyoming, a government irrigation expert, gave an illustrated lecture on irrigation in Egypt that was interesting. Mr. Johnson is a young man and is now

at the head of the government work in Wyoming, having succeeded Prof. Elwood Mead in that position.

The third day of the congress opened with addresses by Congressmen Tawney, Heatwole, Stevens and Morris, of Minnesota, Williamson of Oregon, and J. M. Carey, of Wyoming. Speeches were also made by Frank Trumbull, president of the Colorado and Southern railway, and C. M. Hobbs, of the Denver and Rio Grande Company.

After a fight lasting over four hours, the congress decided to postpone for one year the matter of merging with the Trans-Mississippi congress.

The resolutions dealt with national irrigation only in a general way. The president, secretary of agriculture, and secretary of the interior, as well as members of congress, were thanked for their aid.

It was decided that no one project should be recommended for construction, as had been urged and hoped for by the delegations from different points where government aid is of vital importance. Resolutions regarding state laws were introduced and defeated. There was adverse comment concerning the fact that so much time was given to representatives of commercial bodies in preference to the prominent irrigation engineers and experts, who, it was expected, would deliver discourses on the subjects of importance to the irrigation industry.

This was said to be due in part to the active work of the commercial contingent, headed by George H. Maxwell, who aimed to carry the weight of both the irrigation congress and irrigation association on his shoulders. Mr. Maxwell received censure from a large number of the delegates, who objected to his plan of engineering all moves of the congress, regardless of the wishes of the majority. The general impression is that the railways, in whose interest Mr. Maxwell is supposed to act, would have achieved more substantial support if their matters had been looked after by one who was in better harmony with the convention.

As stated by a prominent delegate, "the fact of the matter is that the railway companies who have done so much for the western country, and who still stand ready to go on with the good work, are greatly handicapped by this kind of representation."

During the third day's session, Col. Thomas Holland, national colonization secretary of the Salvation Army, read a paper by Commander Booth-Tucker, on the subject of colonization. After referring to the success of the efforts of the Salvation army in furnishing men with the necessary capital and settling them as home owners upon the land, the commander said the fact that the present irrigation congress has included in its deliberations this great question of colonization will undoubtedly place the subject in an entirely new light before

the country and will give to colonization an impetus the influence of which will leave its mark on generations to come.

The meeting Wednesday night, which settled for one year at least the question of a merger with the trans Mississippi congress, was a stormy one and lasted for several hours. The question of a merger was championed by two or three prominent members and was quietly handled in committee and sprung on the congress with a view of railroading it through, but the move was blocked by Senator Carey of Wyoming, who urged that time should be given the delegates for consideration of the subject.

Senator Carey and other speakers maintained that the delegates should not be urged to destroy the identity of the congress by becoming part of the trans Mississippi cougress, and it was further urged by other delegates that there was a strong possibility of the latter organization taking on a political complexion which would materially injure the irrigation interests in case of a merger

Mr. Kiesel presented the following minority report for the executive committee of which it was fortunate he was a member.

MINORITY REPORT OF THE EXECUTIVE COMMITTEE.

In presenting the Minority Report on the proposition to merge the Irrigation Congress with the Trans-Mississippi Congress I regret to stand in the attitude of the only dissenting member of the Committee; a position which I realize to be not very enviable, but in the performance of it I recognize a solemn duty, profoundly impressed, that such a combination will impair the prestige and usefulness and may destroy the identity of our organization which should be paramount and must be preserved at all hazards. I cannot but see in this attempt an effort of the Trans-Mississippi Commercial Congress to bolster up their own claims however just they may be. This in my judgment should not be done at the expense of our movement. It is manifestly not our place nor our interest to agree to meet at a point selected already in advance by the other organization indicative and disclosing a desire to dominate in the combination.

It is essential that the next Irrigation Congress should hold its session at some central point in the arid region occularly demonstrating and practically teaching all that has been said and claimed from the rostrum. Respectfully

FRED J. KIESEL.
Member for Utah.

Geo. H. Maxwell made a long speech in favor of a merger, which did his side much harm, as a large number of delegates switched to the anti-merger side after he closed. Those who made the change contend that when an attempt is made to force through a deal of this kind there must be some hidden motive. Much dissatisfaction was

expressed by the fact that so much time was devoted to politics and the discussion of matters of comparative little importance that such men as Dr. Newell and Prof. Mead were not given an opportunity to deliver their addresses until so late at night that a large number of the delegates had retired.

On Thursday, after the wrangle over the merger had quieted down, the congress proceeded with the regular order of business and election of officers and appointed a committee to report on the consolidation proposition next year.

The following officers were elected:

President—Col. Edwin F. Holmes, Salt Lake, Utah.

First Vice President—Gov. L. Bradford Prince, Santa Fe, N. M.

Second Vice President—Anson J. McCune, Denver, Colo.

Third Vice President—E. H. Libby, Clarkston, Wash.

Secretary—Col. H. B. Maxson, Reno, Nev.

Executive Committee—Oregon: E. M. Brannick, vice president; Jas. M. Moore. New Mexico: G. A. Richardson, vice president; C. J. Gavin. Wyoming: Fred Bond, vice president; Jos. M. Carey. Missouri: Thos. Knight, vice president; S. W. Rider. South Dakota: Wm. H. H. Beadle, vice president; Henry E. Perkins. Montana: W. M. Wooldridge, vice president; I. D. O'Donnell. Nevada: J. A. Miller, vice president; J. E. Stubbs. Ohio: Will H. Brill, vice president. Kansas: John Hall, vice president; E. R. Moses. Illinois: James W. Wilson, vice president; D. H. Anderson. Nebraska: Euclid Martin, vice president; A. M. Allen. Washington: P. A. Getz, vice president; J. W. Clise. Arizona: A. J. Chandler, vice president; B. A. Fowler. Iowa: J. K. Mason, vice president. New Hampshire: Mr. Henry Jacques, vice president. Utah: L. W. Shurtliff, vice president; Fred J. Keisel. Colorado: B. F. Rockafellow, C. E. Wantland. Idaho: O. E. McCutcheon, E. M. Kirkpatrick.

Immediately upon the adjournment of the congress Thursday noon, the executive committee organized, with Fred J. Keisel as chairman, and Col. H. B. Maxson as secretary.

The new president, Col. Edwin F. Holmes of Salt Lake City, is a man of wealth, who will no doubt devote considerable time and money to make the congress at Ogden a success. Col. Holmes, in accepting the office, said:

"I am satisfied that irrigation and forestry are leading questions of the day. We hardly realize the importance of the work in hand. I intend to devote myself earnestly to the work."

The resolutions, after facilitating the American people upon the enactment of the national irrigation act, say:

"The grateful acknowledgements of this congress are due to Theodore Roosevelt, president of the United States, for his invalu-

able assistance in the cause of irrigation. His message to congress in December, 1901, marked the beginning of a new epoch in the history not only of the arid west but also of a new epoch in that of the whole nation. Without his powerful aid and that of his administration it would not have been possible to secure the passage of that great act, which will inaugurate and put into effective motion the national irrigation policy, for which we have been striving so long.

"Great as his administration may be, we believe that none of its achievements will redound more to the greatness of our people and the glory of our country than will the passage of the national irrigation act. We send him our greetings and give him our assurance of our most sincere respect and admiration."

Resolutions were also passed recommending the protection and preservation of forests and urging the co operation of national and state government to this end.

The following is a list of delegates who were in attendance:

ARIZONA.

E. W. Wilbur, Mesa.
W. W. Pase, Thatcher.
Dwight B. Heard, Phoenix.
L. A. McAfee, Phoenix.
Jno. Fairweather, Reedley.
J. W. Woolf, Tempe.
A. J. Chandler, Mesa.
B. A. Fowler, Phoenix.

CALIFORNIA.

Fred L. Alles, Los Angeles.
Jerome O. Boger, Redlands;
Jas. H. Adams, Los Angeles.
C. B. Booth, Los Angeles.
G. W. Burton, Los Angeles.
W. W. Richards, San Francisco.
Scipio Craig, Redlands.
G. H. Maxwell, San Francisco.

COLORADO.

A. B. C. Saunders, Ft. Morgan.
Wardner Williams, Denver.
F. D. Keifer, Fruita,
Jno. R. Sitlington, Fountain.
L. J. Finch, Montrose.
H. N. Maynes, Greeley.
T. J. Black, Colo. Springs.
W. S. Wallace, Grand Junction.
R S. Briscoe, Colorado City.
B. Freeman, Durango.
W. B. Wesley, Longmont.
Mrs. L. G. Carpenter, Ft. Collins.
W. I. Whittier, Monte Vista.
Max Kuner, Denver.
R. L. Holland, Colo. Springs.
P. B. Godsman, Burlington.
T. B. Pyles, Colo. Springs.
Lee W. Davis, Victor.
A. T. Morgan, Silverton.
E. R. Chew, Pueblo.
Gordon Jones, Fountain.
David Cocker, Amity.
L. A. Doole, Amity.
Barnard L. Olds, Pueblo.
J. W. Beatty, Fowler.
H. Pollard, Pueblo.
C. K. McHarg, Pueblo.
Anthony Bott, Colorado City.
L. G. Carpenter, Ft. Collins.
John F. Stott, Burlington.
F. T. Lewis, La Junta.
A. C. Draper, La Junta.
T. A. Hazlitt, Colo. Springs.
A. W. Winegar, Burlington.
L. M. Latta, Lanear.
D. J. McCanns, Denver.

S. J. De Lan, Glenwood Springs.
M. Strain, Lamar.
Jno. Sittington, Fountain.
H. G. Lunt, Colo. Springs.
E. M. Kelsey, Sterling.
W. E. Rockwell, Sterling.
P. Peterson, Julesburg.
J. D. Kirby, Atwood,
Robt. Parker, Sterling.
Wm. J. Kerr, Pueblo.
Judge H. G. Lunt, Colo. Springs
G. C. Johnston, Denver.
F. H. Brandenburg, Denver.
A. B. Moulton, Denver.
W. E. Condon, Denver,
Lute Wilcox, Denver.
Maj. R. R. Hughes, Jr., Denver.
Henry I. Reed, Colo. Springs.
C. E. Wantland, Denver.
John S. Titcomb, Denver.
W. H. McClure, Canon City.
W. A. Platt, Colo. Springs.
Fred F. Horn, Colo. Springs.
W. P. Woodside, Colo. Springs.
I. N. Stevens, Colo. Springs.
A. L. Fellows, Denver.
J. W. Vandeventer, Sterling,
F. R. Baker, Ft. Collins.
W. P. Epperson, Colo. City.
J. J. Cheairs, Sterling.
M. C. King, Sterling.
W. C. Henry, Sterling.
Jas. J. Armstrong, Greeley,
A. G. Sharp, Colorado Springs.
R. H. Malone, Denver.
David Roberts, Grand Junction
H. M. Hogg, Telluride.
M. T. Burwell, Colo. City.
G. M. Hall, Rocky Ford.
J. E. Wilson, Logan.
J. A. Freelove, Florence.
F. W. Swanson, Alamosa.
J. N. Bartels, Pueblo.
Henry Nichols, Grand Junction.
Jno. C. Reagon, Sterling.
W. N. Randle, Rocky Ford.
Jno. Davy, Amith.
Willisford Dey, Pueblo.
S. S. Whitlow, Centerville.
Jno. I. Franklin, Colo. Springs.
J. A. Hays, Colo. Springs.
C. B. Goddard, Sterling.
David Beattee, Sterling,
E. M. Gillett, Sterling,
C. Peterson, Julesburg.
C. B. Timberlake, Sterling.
D. E. Newcomb, La Junta.
Jno. G. Shields, Colo. Springs.
Walter N. Houser, Walsenburg.
R. S. Russell, Greeley.
A. J. McCune, Denver,
John E. Field, Denver.
Chas. O. Springer, Denver.
Ulrich W. Sprague, Denver.
H. W. Nicholson, Denver.
R. E. Goodell, Denver.
Hon. A. E. Ahlers, Colo. Springs.
S. H. Atwater, Canon City.
W. G. Sprague, Denver.
W. W. Williamson, Colo. Springs.
W. H. McBroom, Colo. Springs.
E. A. Sawyer, Colo. Springs.
Jno. E. Pelton, Montrose.
Jonathan Williams, Sterling.
H. I. Reid, Colo. Springs.
Jno. C. Bell, Montrose.
W. J. Powell, Sterling.
R. G. Sherwin, Sterling.
F. W. Rieke, Sterling.
Harvey C. Harris, Colo. Springs.
Henry Templeton, Colorado City.
L. H. Dickson, Longmont.
B. D. Sanborn, Greeley.
A. Hannah, Florence.
Olive A. Killin, Kiowa.
H. F. Kane, Eagle.
W. J. Kitely, Longmont.
B. F. Rockafellow, Canon City.
W. K. Winterhalter, Rocky Ford.
Wesley Staley, Hooper,
C. B. Schmidt, Pueblo.
Jno. B. Harper, Durango.
Thos. Holland, Amith.
T. H. Johnson, Loveland.
W. A. Thomas, Montrose.
F. Hermann, Falcon.

Jas. A. Hart, M. D., Colo. Springs.
D. W. Working, Denver.
R. M. Jones, Victor.
F. H. Frankenberg, Pueblo.
Thos. Kneale, Niwot.
T. R. Henahen, Montrose.
W. B. Gobin, Rocky Ford.
J. B. Kilbourn, Pueblo.
Geo. A. Kilgore, La Junta.

DISTRICT OF COLUMBIA.

Arthur P. Davis, Washington.
L. A. Powers, Washington.
Guy E. Mitchell, Washington.
Thomas F. Walsh, Washington.
W. B. Dunton, Washington.
Prof. Elwood Meed, Washington.
F. H. Newell, Washington.

FLORIDA.

W. E. Pabor, Avon Park.

IDAHO.

C. C. Stevenson, Boise.
E. M. Kirkpatrick, Roswell.
A. E. Gipson, Caldwell.
J. M. Wells, Idaho.
W. C. Annett, Boise.
O. E. McCutcheon, Idaho Falls.
Lorin Mendenhall, Franklin.

ILLINOIS.

W. R. Martin, Chicago.
D. H. Anderson, Elgin.
Jas. W. Wilson, Chicago.

IOWA.

M. W. Grimes, West Union.
H. P. Lockwood, Sioux City.
Jno. Scott, Jr., Sioux City.
J. K. Mason, Keokuk.
A. S. Wasson, Sioux City.
C. S. Peters, Sioux City.

KANSAS.

A. T. Smith, Lyons.
G. W. Baily, Wellington.
Geo, C. Kincaid, Great Bend.
John Hall, Syracuse.
Robert Findlay, Sterling.
D. E. Lantz, Manhattan.
J. F. Morse, Philipsburg.
W. G. Russell, Russell.
E. R. Moses, Great Bend.
R. M. Chilcott, Wamego.

MINNESOTA.

Jno. Brisben Walker, Minneapolis.
J. J. Windle, Minneapolis.
Fred C. Stevens, St. Paul.
B. F. Beardslee, St. Paul.
Prof. Thos. Shaw, St. Anthony Park.
E. J. Phelps, Minneapolis.
Albert L. Preston, Duluth.
Marcus Johnson, Alexandria.
A. L. Cracken, Minneapolis.
Randolph Walker, Minneapolis.
T. L. Schurmier, St. Paul.
Hon. D. W. Lawler, St. Paul.
C. Heffilfinger, Minneapolis.
Hon. Page Morris, Duluth.
W. H. Dunwoody, Minneapolis.
Hon. Joel. P. Heatwell, Northfield.
Hon. J. A. Tawney, Winona.

MISSOURI.

M. Von Schrenk, St. Louis.
Tarleton H. Bean, St. Louis.
T. W. Rider, Kansas City.
Thos. Knight, Kansas City.

MONTANA.

W. B. Sands, Chinook.

NEBRASKA.

A. C. Banks, Lexington.
J. W. Dougherty, Omaha.
J. A. Fort, North Platt.
Adna Dobson, Lincoln.

B. E. Forbes, Lincoln.
Lee Armitt, Lincoln.
J. E. Utt, Omaha.
Geo. H. Lee, Omaha.
J. G. Hamilton, Crawford.
W. R. Lighton, Omaha.
Jas. Ferrier, Culbertson.
I. D. O'Donnell, Billings.
Rome Miller, Omaha.
Sam'l. D. Cox, Minatare.
Peter Jansen, Jansen.
S. C. Smith, Beatrice.
H. O. Smith, Lexington.
M. H. Marble, Table Rock.
Robt. R. Kyd, Beatrice.
M. Wulpi, Omaha.
W. H. Fanning, Crawford.
Page T. Francis.
C. H. Dietrich, Hastings.
C. H. Meeker, McCook.
Robt. McReynolds, Lincoln.
A. M. Allen, Oothenburg.
David Brothers, Edgar.
E. S. Bradley, Omaha.
J. L. Epperson, Fairfield.

NEVADA.

H. B. Maxson, Reno.

NEW YORK.

Mrs. Estella True Knell, New York.
L. G. Palmer, New York.
Andrew Cant, Buffalo.
W. H. Brevoort, New York

NEW MEXICO.

H. R. Morrow, Roswell.
Jason W. James, Roswell.
L. H. Brown, Deming.
C. J. Gavin, Raton.
A. L. Hobbs, Raton.
R. W. Tansill, Carlsbad.
L. K. McGaffey, Roswell.
W. M. Reed, Roswell.
G. A. Richardson, Roswell.
F. H. Pierce, Las Vegas.
L. Bradford Prince, Santa Fe.

NORTH DAKOTA.

J. J. Youngblood, Fessenden.
Chas. M. Hall, Fargo.

NEW HAMPSHIRE.

Capt. Wm. H. Jaques, Little Boar's Head.

OHIO.

Walter Brill, Cleveland.

OREGON.

J. N. Williamson, Prineville.
A. M. Drake, Bend.
D. H. Stearns, Portland.
Jas. M. Moore, Portland,
A. King Wilson, Portland.

SOUTH DAKOTA.

J. J. White, Ree Heights.
Dr. O. S. Merager, Sieux Falls.
A. B. Crane, Brookings.
E. M. Ammons, Sioux Falls.
Wesley A. Stuart, Sturgis.
Florence E. Merager, Sioux City.

TEXAS.

Henry Sayles, Abiline.
Chas. McDade. Canyon.
J. A. Komp. Wichita Falls.

UTAH.

Preston A. Blair, Ogden.
A. H. Gunnell, Ogden.
Heber C. Jex, Spanish Fork.
J. K. Ryckman, Salt Lake City.
E. T. Holmes, Salt Lake City.
V. C. Gunnell, Ogden.
J. S. Free, Salt Lake City.
E. R. Morgan, Salt Lake City.
T. H. Bigelow, Ogden.
W. B. Ennis, Draper.

Fred J. Keisel, Ogden.
Mr. Bartell, Ogden.
Chas. Block, Salt Lake.
Jos. Hubbard, Salt Lake City.
H. Bennion, Vernal.
Mosia Evans, Lehi.
Peter Larsen, Salt Lake City.
Louis C. Kelsey, Salt Lake City.
Richard W. Young, Salt Lake City.
John Henry Smith, Salt Lake City.
Wm. Blood, Haysville.
David Keith, Salt Lake City.
Gustave J. Barthel, Ogden.
J. W. Houston, Salt Lake City.
Alvin M. West, Corinne.
Mrs. V. N. Bennion, Vernal.
Orson H. Gavitt, Ogden.
O. H. Hewlett, Salt Lake City.
Angus M. Cameron, Salt Lake City.
Geo C. Lambert, Salt Lake City.
Fred. W. Eastman, Ogden.
Geo. A. Lowe, Salt Lake City.
Wm. Price, West Jordan.
Amos S. Gabbott, Salt Lake City.
F. A. Druehl, Salt Lake City.
O. P. Miller, Salt Lake City.
Francis McDonald, Holliday.
J. R. Ekman, Salt Lake City.
A. F. Doremus, Salt Lake.
L. W. Shurtliff, Ogden.
Pauline R. Doremus, Salt Lake.

WASHINGTON.

Jno. A. Parker, Tacoma.
Arthur Gunn, Wenatchee.
E. H. Libbey, Clarkston.
E. T. Blaine, Seattle.
Lester W. Satlerlee, Tacoma.
Dr. A. T. Baker, Chewelah.
P. A. Getz, Ellinsburg.

WISCONSIN.

J. L. Schaefer, N. Greenfield.
B. N. Arpin, Grand Rapids.
S. L. Arpin, Grand Rapids.
C. Arpin, Grand Rapids.

WYOMING.

C. E. Tait, Cheyenne.
F. C. Williams, Sheridan.
J. A. Breckons, Cheyenne.
Jos. M. Carey, Cheyenne.
O. J. Midthun, Lander.
Louis C. Maneval, Cheyenne.
E. Crumririe, Laramee.
Fred Bond, Cheyenne.
Burton P. Fleming, Laramie.
T. H. Statts, Sheridan.
B. F. Barye, N. Yakima.
C. B. Sterrett, Saratoga.
W. S. Collins, Basin.
Harry B. Henderson, Cheyenne.
Henry A. Coffeen, Sheridan.
E. J. Bell, Laramie.
C. E. Johnston, Cheyenne.
J. W. Priee, Casper.

I. B. Leach, Queenstown, Cape Colony.

NOTES ON THE CONGRESS.

Mr. Richard W. Young, a prominent attorney of Salt Lake City, was one of the delegates from Utah.

When does the National Irrigation Association hold its annual meeting? The IRRIGATION AGE would like to send a representative even if the only other individuals in attendance are Geo. H. Maxwell and Guy E. Mitchell.

One of the prominent delegates from Arizona was Mr. B. A. Fowler of Phoenix.

Our interesting friend, C. J. Gavin of Raton, New Mex., was in attendance and entertained lavishly in the New Mexico headquarters

Antlers hotel. Mr. Gavin is an attorney of prominence in his city and is known throughout the country as a staunch friend of irrigation.

Among the newspaper men present was John Fairweather of The Exponent, Reedley, Cal.

Clarence T. Johnston of Cheyenne, Wyoming, who is considered one of the most promising young men connected with the office of Experiment Stations, U. S. Department of Agriculture, delivered a very interesting lecture on Irrigation in the Nile country, which was splendidly illustrated by stereoptican views produced from photographs taken by him while on a recent trip through that country.

Mr. S. W. Rider, who was a delegate from Kansas City. Mo., is assistant Secretary of the United States and Mexican Fruit Company of that city. This company is financing the new Orient railway line from Kansas City to Port Stillwell on the Gulf of California in Mexico.

Mr. Truman G. Palmer of Irving Park, Ill., was a visitor during the congress and made many friends among the delegates whom he was anxious to instruct as to the possibilities of bad effects on the beet sugar industry by any congressional action in favor of the Cuban product. Mr. Palmer is thoroughly well posted on this subject and will contribute an article for these columns in the near future.

Mr. E. H. Fourt a well-known attorney of Lander, Wyoming, was an able second to Senator Carey in championing the anti-merger movement.

Our old friend E. R. Moses, of Great Bend, Kansas, who has labored so long and faithfully for the cause of irrigation, was in attendance and as active and full of vigor as of old. Mr. Moses is a leading merchant in his home city and is interested in mercantile establishments in several live cities of his state. He is also interested in several banks at home and elsewhere.

Mr. Fred J. Kiesel a leading wholesale grocer of Ogden, Utah, who is also a large ranch owner in Oregon and Utah was one of the most active opponents of the merger and is entitled to great credit for the manner in which he handled his delegation.

The many friends of Scipio Craig, Redland, Cal., were glad to note his presence. Mr. Craig is editor and publisher of the *Citrograph*, one of the cleanest and most unique publications in the country. During a conversation with Mr. Craig the writer asked him how warm it got in Southern California. He replied that the hottest weather he ever knew anything about was on the border of Death's Valley, when it has been known to register 136 in the shade. Mr.

Craig laughingly remarked that a man was not compelled to remain in the shade unless he chose to.

President Thos. F. Walsh was suddenly called away from Colorado Springs, the second day of the Congress, by business connected with his mining interests. He made a hurried trip with John Hays Hammond and Frederick T. Baker, of the Camp Bird Mines, of London, Eng., and Ouray, Colo. Mr. Walsh wired his regrets to the congress and stated later, on his return to Denver, that his trip, which required a long journey on horseback over the mountains, was absolutely necessary, otherwise he would not have absented himself from the meeting during its sessions.

Mr. W. A. Platt, editor of thc *Telegraph*, the leading evening paper of Colorado Springs, was very kind to visiting delegates. His paper has one of the best equipped offices in the state.

The secretary, Mr. H. B. Maxon, was uniformly courteous and attentive to delegates and others. Mr. Maxon is interested in a large railway project, acting for the Clark system in the far west. He is consequently a very busy man.

David Keith, one of the mining kings of Utah, found time to attend as a delegate. His work on the merger question was of value.

Judge L. W. Shurtliff, Salt Lake City was one of the most conspicuous delegates from Utah.

Mr. and Mrs. R. W. Tansill, of Carlsbad, N. M., were in attendance. Mr. Tansill was compelled to move to the west some years ago on account of ill health and has established a home there and is a very successful business man in the Pecos Valley.

Mr. Thomas Knight, of Kansas City, was one of the bright delegates, who has been active in irrigation affairs since the first congress.

Lute Wilcox, editor of the *Field and Farm*, Denver, was in attendance and worked solidly against the merger. Mr. Wilcox is author of Irrigation Farming, published by the Orange Judd Company, New York, a work which is standard among all who are interested in that subject.

C. E. Wantland, Chairman of the Executive Committee, was one of the men who worked from start to finish. His efforts on behalf of the congress were too much for him and a physical collapse was the result. He rapidly recovered and was in at the finish. Mr. Wantland is agent for the Uunion Pacific Ry. lands at Denver and Salt Lake City and is editor of *Ranch News*.

Prof. L. G. Carpenter, of Fort Collins, Colo., accompanied by Mrs. Carpenter, was in attendance.

THE HUMANITARIAN ASPECT OF NATIONAL IRRIGATION

ADDRESS OF HON. THOMAS F. WALSH.

Gentlemen of the Convention:—

We assemble to-day under very pleasant circumstances. We are here not merely to discuss measures, to formulate resolutions, and to map out a plan of campaign, as we have so often done on former occasions. But we are here, first of all, to celebrate a great victory—to rejoice at the birth of a new policy which the National Irrigation Congress has given to the nation. It is a happy hour in the history of the great West.

It is our first and grateful duty to acknowledge our obligations to the men and the influences that made it possible to put a national irrigation law on the statute books in the summer of 1902. It is true, as ex-Secretary Boutwell remarks, in his book of reminiscences, that when great measures are finally brought to pass they are usually due to no single individual. They are the product of many circumstances and many minds, and the actual event is the culmination of much that has gone before. This is pre-eminently true of the bill which recently became a law and which is so soon to be placed in operation in reclaiming desert lands in some of the Western States.

In this hour of triumph we owe a word of thanks to the enthusiastic and far-sighted men who inaugurated this movement a dozen years ago. They saw, on one hand, what had been accomplished by the pioneer settlers among these far western valleys, and, on the other hand, they saw a vast area of rich land which was practically worthless unless reclaimed by irrigation. They realized that here a new population, as great as the present total of the United States, might be sustained in a high degree of comfort and prosperity. If they did not clearly see the practical steps by which this was to be accomplished, they at least realized that they had encountered a new national problem of magnificent dimensions. They set themselves to arouse the interest of the nation in this grand undertaking, and to that end they organized this Congress as an instrument in the work.

The report of Capt. Hiram M. Chittenden on the storage of flood waters marked a new era in the national irrigation movement. It was probably the strongest single influence which turned the thought of our people toward the policy of national construction of reservoirs. Following closely upon this report, and largely inspired by it, came the National Irrigation Association as an auxiliary and co-worker of this Congress. With it came a new and aggressive influence which gave definite shape to the entire movement, and which accomplished

extraordinary results in the enlistment of the strongest minds and most powerful organizations in behalf of national irrigation.

The National Irrigation Act is the outgrowth of a wide-spread public sentiment which was created by these agencies and by the very considerable body of literature which they called into being. But there could have been no substantial success at this early day had we not been extremely fortunate in the character of our public men at Washington. First and foremost, our grateful acknowledgements are due to Theodore Roosevelt, President of the United States. His message to Congress, in December, 1901, marked the beginning of a new epoch in the history of Western America. It placed the cause of national irrigation in a position where it could no longer be denied. Without the powerful aid of the administration we could not possibly have succeeded in inaugurating the new policy at so early a day. With all due regard to his other achievements, and to the importance of other objects both of domestic and of foreign concern, I do not hesitate to say that in my opinion, when the history of President Roosevelt's first administration shall be written, the passage of the National Irrigation Act will be found to be the peculiar glory of his statesmanship, and our thanks are due to the Honorable E. A. Hitchcock, Secretary of the Interior and to the Honorable James Wilson, Secretary of Agriculture. Nor should we forget our faithful friends in both Houses of Congress. They were found in both parties and were by no means all from our section of the country. While our measure by no means escaped criticism, it is a pleasure to be able to record the fact that when they came to a vote the instinct of provincialism was completely overwhelmed by the broad spirit of nationality. Our thanks are also due to the great commercial interests of the United States which took the broadest possible view of the proposition and lent their potent influence to our cause.

The inauguration of the National Irrigation policy means a great deal to all our Western States. It will add immensely to their wealth and population and greatly broaden the basis of their prosperity. It means even more to the nation as a whole. It opens the way to a new era of internal development and domestic expansion as great as any similar period of the past. It is equivalent to the addition of a new empire as important as that drained by the Mississippi River and its tributaries. But these are not the considerations which are uppermost in my mind as I contemplate the results to flow from this new policy. It is what may be called the humanitarian aspect of national irrigation which quickens my pulse and makes me desire to dedicate myself anew to the work in which we are engaged.

The inauguration of national irrigation means that every family in the United States who wants a home upon the soil may have one.

It means that the door is open to permit the man, who is not needed where he is, to go to the place where he is needed. It means the restoration of those automatic-social conditions which in past generations relieved the pressure of population upon the old centers and constantly extended the frontiers of civilization toward the North, the South, and the West. When we read the history of the people of the United States in McMaster's pages, for instance, we are surprised to find at how early a date there was serious unrest because of the crowding of population and consequent depression of industry. Immediately after the close of the Revolution there was marked evidence of land hunger, and a fierce demand for more territory with which to feed the appetite for homes. It was then that the Ohio valley received its first influx of settlers from the Eastern States. So it was again after the close of the Rebellion, when the prairie states to the west of the Mississippi sprang into sudden existence, and when the tide of emigration flowed out upon the plains until it came within sight of the Rocky mountains. We stand upon the threshold of another great colonization movement made possible by the glorious fact of national irrigation.

It is not, however, to broad movements of population that I especially desire to direct your attention in the brief time at my disposal. I am thinking rather of the family unit—of the father and mother and little children now confined within the narrow limitations of city life. I am thinking of how their horizon is to be broadened, and how their daily lives are to be enriched, by the transition from paved streets and crowded tenements out under the blue sky and into the sweet, pure air which we know and love so well. It is not the dream of empire, which may come to a great nation with the conquest of a territory wherein a hundred million will sometime dwell, which appeals to my imagination. But it is the dream of home and independence which will come to many a struggling family with the announcement that one more fair valley of Arid America has been thrown open to settlement at the actual cost of reclamation. I picture to my mind the ambitious young man and woman just starting life and disheartened at the conditions offered them by the harsh competition of the town. I see the couple of middle age, with their children about them, wondering how they are to make provision for old age. I see the men of talent and ambition, some of them broadly trained in the trades and professions, who are yet unable to prosper in the midst of our changing economic conditions. These, and many other classes, I see living in hired houses and working at small wages for others more favored in ability or fortune. I know the pressure of poverty upon them, and the haunting fear of future want. Such people, and many of our best stock and breeding, are found all

over the land, but especially in great cities, where the very forces which have created our present prosperity as a nation have also operated to make a certain fringe of half-employed and semi-prosperous. And then I see National Irrigation like a good fairy, wave its magic wand; and lo! a new star of hope arises in the sky of our common humanity. A new vista opens before thousands of families. Opportunity comes with beckoning finger. It points the way to a new Land of Promise. Hope chases anxiety from a thousand faces, and a new enthusiasm for home and independence drives apprehension from a thousand hearts.

This is to me the inspiring and uplifting aspect of national irrigation. True, we are to have millions of people living where few lived before. We are to see a vast increase in national wealth. But all this is merely incidental to the human aspect of the matter, which is the making of homes for the homeless and the giving of social and industrial independence to those now dependent on the enterprise of others. Let us take care of the family and the nation will take care of itself.

Let us look a little closer into this wonderful social process which is to be brought about by the new national policy. I think perhaps the time has come when something should be said about the attractions of rural life for the masses of our people. We have heard a great deal about the allurements of the towns and the manner in which they draw to them the cream of our young men and women. Living in the country has become unpopular. Nobody but old folks and foreigners can endure such an existence. Everybody else looks for a situation in the big city—and the bigger the better. It is undeniably true that the tide has been setting away from the soil, and that both here and abroad the cities have been rolling up to portentous proportions. Are there any signs of a reaction? I think there are. In the first place, country life is becoming fashionable again. The abandoned farms of New England have been largely bought up to be converted into the country estates of well-to-do city people. These city people are extending their vacations a little more each year. It is now almost customary for them to spend about six months on the farm. Simultaneously with this we see a new literature springing up in response to it. There is no end of new books about birds and flowers and domestic animals. There are new periodicals which have quickly acquired a large circulation because they deal attractively with this subject.

Now, to my mind this new phase of our social life has a very deep significance. I hope and believe that it is not a mere fad or passing fashion. In my opinion it is a manifestation of one of the strongest traits of human nature. And that is man's inherent and inerradicable

love for the soil. This is our natural taste, while the fascinations of town life are artificial. They do not satisfy our deeper feelings. Some one has said: "Religion is that fine sense of soul that brings the individual into touch with Universal Purpose." I have walked the streets of the finest cities in the world, but pavements and hotels and business blocks never touched that spring in my being which gave birth to such a sentiment. On the other hand, I have climbed the rugged and picturesque sides of our great mountain ranges. I have stood upon the summits of some of their lofty peaks and beheld the beautiful panorama of snow clad ranges, their mighty forms lifting far above the abodes of men and extending for miles in every direction. I have gazed at the sky and I have listened to the birds and to the roar of the mountain streams. And there, indeed, I have felt "that fine sense of soul which brings the individual into touch with Universal Purpose." Without attempting to elaborate the idea, I undertake to say that there is something in the heart of the dullest man who ever lived that responds to the beauties of nature. I firmly believe it is this instinct which is sending the well-to-do from the cities to the country, and which in the next few years will make the reclaimed areas of the arid West sought after by the very best elements of our middle class population.

James G. Blaine, in his eulogy of Garfield, referred to the fact that our second martyred President was popularly supposed to have been reared in direst poverty. The orator then went on to draw a contrast between the poverty of city life and the "clean, sweet poverty of the country." He showed that in the one case evil influences predominate, while in the other there is every inspiration to noble endeavor. This is absolutely true. It constiiutes one of the very strongest arguments in favor of national irrigation. In how many biographies of successful men—of men who have risen in politics, in business, in the professions and in the arts—do we read the same familiar story of inspiration drawn from the strenuous experiences of a poor family reared in the country.

Now, the influences of rural life to which Blaine referred in speaking of Garfield's boyhood are going to be far more wholesome and far more inspiring in our mountain valleys and in this twentieth century than they were in the Western Reserve of Ohio in the first half of the nineteenth century. I cannot impress this point too strongly upon your minds. The man who rears his sons and daughters in the rural life of our irrigation empire will give them a better chance to become useful men and women than boys and girls will have when raised in the city—a better chance, even, than young people enjoyed in the brave old days of which we read in the biographies of our great men. Let me show you what I mean.

The irrigated farm is necessarily a small farm. It must be so because it is expensive to build and maintain reservoirs and canals. Not only so, but irrigation so largely increases the productive capacty of each acre as to make twenty acres practically equal to one hundred acres depending upon rainfall. The small farm means plenty of neighbors. And that, in turn, means social advantages which were not within reach of country people in the boyhood days of Garfield Lincoln, and others of their generation. The boys and girls of Arid America will have the intellectual stimulus which goes with neighborhood association. Thus they gain one of the chief advantages for which so many people are rushing into the towns. But this is only half of their advantage. The other half is the industrial independence and the glorious contact with nature which come with life on the irrigated farm.

The boys and girls who grow up in the great city learn from the beginning their dependence upon others. They must work for others as a means of livelihood, as their fathers are doing. They must live in houses which other men own. Why, mother cannot have a new sink in the kitchen without first petitioning the landlord and convincing that august personage that the expenditure is really demanded in the interests of economy or comfort.

Ah how different it is with that family when they acquire their part of the national heritage—a little irrigated farm in Colorado, in Idaho, in California or any other of our beautiful Western States. The soil which they press is their own soil. The roof that shelters them is their roof. Now father works for himself and for his babies. When mother needs a new sink in the kitchen there is nobody to ask except the man who loves her. This is freedom. What does it mean to the nation to have millions of people gradually pass from the servitude of the town to the sovereignty of the country? It means, my friends, the enlistment of a new army for the defense of the Republic in every hour of need. Give a man a home upon the soil and you have made him into a patriot who will defend your institutions at the ballot box and on the battlefield.

This is a very fascinating subject to me and I would like to pursue it at much greater length. I cannot take your time for this purpose. But I wish to impress clearly upon your minds that it is the humanitarian aspect of national irrigation which will move our countrymen and induce them to enter upon this policy on the grandest scale. Open the doors of the West and you need not worry about the future. Let the people have easy access to the land and most of our other troubles will settle themselves. The property owner is a conservative man who loves his family and his country. Then let the property owner be as numerous as possible.

There never was a time in the history of the world when private benevolence was so common or so generous as it is today. Philanthropists are pouring out their means to build colleges, hospitals and libraries. This is a worthy work which we cannot too highly commend. But I want to avail myself of this opportunity to say that there is no field where benevolence could accomplish so much as in assisting the reclamation and settlement of our great arid region. First, the propaganda which this Congress has carried on for many years might well be endowed with a fund which would enable us to increase the scope and efficiency of our work a hundred fold. Then, we must doubtless devise a means by which the poorest families may be helped to get homes on the soil. Government land at actual cost does not wholly solve the problem. There are railroad fares to be met, homes to be built, lands to be improved, and mouths to be fed before the land comes into bearing. Thus the problem of colonization is by no means wholly solved by putting the water on the land. Foreign governments have dealt with this matter on humanitarian lines. Over eighty years ago, when the streets of Holland were filled with idle veterans returned from the Napoleonic wars, a wise Dutch general planned a series of labor colonies which absorbed all those who were willing to work. Those who did not care to work were chastised until they changed their minds or left the country. New Zealand has a plan by which the government acts as an employment agency, puts men at work in building public utilities, and finally deposits them on the land. I believe we shall soon be called upon to deal with this phase of our social question. Without attempting to suggest any definite plan, I merely throw out the hint that here is a fertile field for private benevolence. I do not see how a man could have a nobler monument than a colony of happy families, or even one family, enjoying the security and independence of life on the irrigated farm.

If you ask me for an example of what might be accomplished in this line I point you to the irrigated valleys of Utah. These were settled by comparitively poor men, many of whom were assisted by a powerful organization. They live on small farms. They enjoy economic independence by the simple method of producing the variety of things which they consume. They live chiefly in villages and so have social advantages not usually within reach of farming communities. It is an amazing statement, but the United States Census vouches for its verity, that of their twenty thousand farms nineteen thousand are wholly free of incumbrance. I love to think of those green oases among the Utah Mountains. If dark hours shall ever come to the Republic, the dwellers in those lovely villages will know nothing of it except by hearsay.

They will continue to live on the fat of the land as long as water

runs down hill. Working for themselves, owning their homes, and living in the midst of congenial neighbors, what have they to fear? Now thihk of arid America, with its hundred million of irrigable land, as densely settled as those Utah valleys. Think of the people who combine the social advantages of town life with the industrial independence of the country. Think of them with their daily newspapers' their telegraphs and telephones, and their rapid means of transportation for products and people. And then realize then that under the plans we propose the humblest citizen of the Republic can pass at will from the discouragiug conditions of town life—if for him they happen to be discouraging—to the inspiring and hopeful opportunities of this new promised lahd.

It is wnen I think of the matteri n this way that my enthusiasm is kindled until mind and heart are ablaze. I thank God that I have lived to see the great policy of nationa. irrigation actually inaugurated I thank God that I have been permitted to have an humble part in bringing it about.

And my friends, let us not permit ourselves to think that our labors in this great work are ended. On the contrary, let us with patriotic zeal dedicate ourselves anew to its advancement. Let us continue to use our influence in keeping it upon a national plane. In locating the first reservoirs to be built where the conditions for ensuring success are perfect. In seeing that the farms created go to actual settlers only. In bringing to the attention of the fortunate and benevolently inclined the great opportunities for the doing of lasting good in helping worthy families to settle upon those new farms. In the building of good roads, the planting of trees, the preservation of the forests, the beautifying of country homes. In utilizing the powers of nature and the modern inventions of man in making country lives and country homes in every way attractive and inviting. You could not be engaged in a more noble work than that for which you have come here today from your distant homes to deliberate upon. It is truly Heaven's work, because its beneficent result will last as long as humanity itself. It is Heaven's work, because in addition to adding great wealth to the nation it will benefit the homeless and the unfortunate of God's children and God will surely bless the government and the people who will carry it to a successful fruition.

PAWNEE GAP RESERVOIR SITE.

While in Colorado recently the writer was invited by the citizens of Sterling, Colo., to visit the proposed site of the Pawnee Gap reservoir, located about fourteen miles northwest of that thriving city. The invitation was extended through the South Platte delegation to the National Irrigation Congress held at Colorado Springs.

As a consequence the writer accompanied by a photographer and Mr. Price, editor of the *Democrat*, Sterling, made the trip on Saturday October 11. That the site is an admirable one is shown plainly by the formation of the proposed dam site, back of which is a water shed seventy miles in length with a natural stone formation coming to two points reaching in semicircular form to within one and a quarter miles of each other and between which lies the narrow pass or valley of Pawnee Creek. In commenting on this site one writer says:

"It now transpires that the most extravagant dreams of the irrigating farmer are about to be realized. Colorado is the first state of the arid region to be benefitted by the law of Congress passed at its late session in aid of irrigation, and the South Platte Valley will have the first reservoir to be constructed by the national government. For years the Hydrographic department has worked to ascertain to what extent the arid lands could be reclaimed, but the new irrigation bill embodies an entirely new feature, namely: What lands will repay the cost of reclamation, which with a reasonable outlay, will show the quickest returns to the government. The site of this reservoir, selected by Hydrographer F. H. Newell of the United States Geological Survey in July last, is known as Pawnee Basin, situated fourteen miles northwest of Sterling, in Logan County, and will, when completed, be named the Pawnee Pass Reservoir. The basin is thirteen miles long and two miles wide. It is one of the largest and most nearly natural reservoirs in the arid west, and has a water-storage capacity computed at 12,444,903,608 cubic feet, forming a huge lake, covering 6,896 acres. The portions of Weld, Morgan, Logan and Sedgwick counties which will receive water from this great reservoir, skirt the Union Pacific Railroad throughout the South Platte Valley in Northeastern Colorado.

To fill this vast basin a canal will be run from the South Platte river, at some point sixty to seventy-five miles above Sterling, having a capacity of 1,500 to 2,500 cubic feet of water a second. Besides this, Pawnee Creek, which empties into the basin, is at flood-tide a raging torrent, and at various seasons of the year will be a material factor in filling the reservoir.

This Pawnee Reservoir site, without a doubt, is exceptional in

that it lays adjoining a large body of arid government land, most of which is subject to homestead entry and is now being taken up very rapidly by parties who readily agree to the clause of the new bill, which requires them to take water from the Government and pay for it in ten annual payments. It also covers a large body of deeded arid lands, many of the owners of which have already signed an obligation to take water from the government under the terms of the bill and others up to 100,000 acres will have signed similar obligations within the next thirty days.

The area to be watered will be one of the richest in the State. Besides the vast new territory to be thus acquired for agriculture, it will become a perpetual source of reinforcement to the irrigation system now in operation in this greatly favored valley. The country is generally level and easily accessible to water, and the combined facilities of government reservoir and the lesser works of a similar nature now in operation will add nearly 1,000,000 acres of fertile agricultural land to the wealth of Colorado. Pending the construction of the great reservoir, the irrigation system as now established in the valley is ample for all newcomers, and all the greater will be the advantages of those earliest on the grounds.

Chief Hydrographer Newell and party standing on one of the Pawnee rocky buttes and looking across the outlet to the rocky buttes on the other side.

We doubt if there are any other sections of country in the United States that have a reservoir site that can show equal possibilities for immediate returns to the government for outlay in building a reservoir.'

"The outlook for general interest," said Chief Hydrographer Newell at Denver recently, "in irrigation is brighter than ever before in the history of the work. A year ago it would have been impossible to have induced congress to have passed the bill which was passed by both houses at the recent session. A great interest has been awakened in the east, and friends of the movement consider the law as only the entering wedge. If the first of the reservoir projects are successful, we may expect a continuance of the good feeling which has been aroused, and additional legislation. Large business men of the East recognize that the development of any part of the country means much to their enterprises, and are heartiiy in favor of federal assistance in extending the irrigated area. I consider the Pawnee Reservoir site, near Sterling, well adapted to the purposes of of my work. Cheesman Lake will be a great success."

"The Pawnee Reservoir," says Geo. R. Caldwell, a well known writer on agricultural matters, "will be nine miles in length; will average over three miles in width and 100 feet in depth. It will be the second largest actually natural reservoir in the United States in point of area, and the first in water-storing capacity, its great California rival, while of larger surface area, being of lesser depth.

"The Pawnee storage capacity runs high into the billions of cubic feet, and its scarcely to be comprehended immensity can perhaps be best expressed by the statement that one filling of the reservoir will furnish enough water to cover to the depth of one-acre foot, 284,000 acres of land—the acre-foot being the accepted water amount for the season irrigation of one acre of ground.

"A quarter of a million acres—150,000 acres in Logan county and the great bulk of the remainder in Sedgwick county—are immediately tributary to the reservoir, while the full development and operation of the great storage basin will add immensely to its irrigation area, the reservoir's properly conserved capacity being estimated as high as 750,000 acres—a prolific factor in final reservoir covering lying in the fact that its waters will also heavily reinforce the already established canal irrigation systems of the region.

"The big basin will be filled twice each season—once during the fall and winter, from the ninety mile long feeding canal, to issue from the South Platte River at Hardin, in Weld County, and once from the flood flow in the spring of the great Pawnee watershed—the latter filling being for summer use.

"The Pawnee watershed has an extent of seventy by fifty miles,

and already this year eight big floods have rushed down Pawnee Creek and roared and rioted through the big basin's mammoth maw.

"The lands under the reservoir can nowhere be surpassed in fertility and general agricultural adaptibility, and will be worth, under irrigation, from $40 to $50 per acre."

Chief Hydrographer Newell Examining some of the Rocks on the top of Pawnee Rocky Buttes.

One of the most progressive towns in Colorado is Sterling the county seat of Logan County. It has now 1,500 people; in the last two years has built one hundred residences and now has twenty-five in course of construction, with at least as many more to follow this fall.

The last two years building includes the $10,000 First National Bank and the $5,000 Central Hotel, while just being finished for full occupancy is the big Logan County Bank, brick and stone block, costing $30,000.

The people of Sterling are alive to the fact that the Pawnee Pass reservoir will be of inestimable value as all the land under it will be tributary to their town. The South Platte Valley delegation to the Tenth National Irrigation Congress was one of the largest and best handled among the many in attendance. We present a photograph of this delegation in group form with the names of the ladies and gentlemen comprising it. In this group may be found the most progressive people in the valley including the bonanza ranchers, merchants, doc-

South Platte Valley Delegation Tenth Congress (See list).

tors, lawyers and editors, with a sufficient sprinkling of ministers of the gospel to give the right tone. The gentleman labled 19, who stands at the extreme right of the group, is the well known colinization agent of the Union Pacific Railway, Mr. Geo. L. McDonaugh who if energy, persistency and everlasting work counts for anything should be drawing at least $10,000 a year from his employers. This photo hardly does Mr. McDonaugh justice and the IRRIGATION AGE will show in some future issue a truer likeness of this genial gentleman. It is our intention to devote attention and space in later issues of the AGE to this site and should the government decide to make its first reservoir at Pawnee Pass we will carefully note progress of work and illustrate it in its different stages of development. The other photos shown illustrate scenes at the time of the visit to this site of Dr. F. H Newell Chief Hydrographer of the United States Geological Survey.

1. C. B. Goddard.
2. E. M. Gillette.
3. Hon. W. J. Powell.
4. J. W. Vandeventer.
5. C. T. Price.
6. A. G. Sherwin.
7. M. C. King.
8. C. Peterson.
9. W. E. Rockwell.
10. Rev. Johnathan Williams.
11. J. C. Reagan.
12. Chas. A. Hayward.
13. J. J. Cheairs.
14. W. C. Henry.
15. P. Peterson.
16. C. B. Timberlake.
17. David Beattie.
18. Robt. Parker.
19. McDonaugh, not delegate, C A., U. P. Ry.
20. Mrs. Robert Parker.
21. Mrs. C. A. Hayward.
22. Mrs. C. B. Goddard.
23. Mrs. E. M. Gillette.

IRRIGATION IN FIELD AND GARDEN.

BY PROFESSOR E. J. WICKSON.

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CHOICE OF AN IRRIGATION METHOD.

In the discussion of the different methods of applying water incidental mention has been made of the particular adaptations of each. It may be further suggested that the choice of method is to be made in accordance with several conditions:

(1) The slope of the land. This is obviously a ruling factor, but its relation to the different methods described has already been discussed in connection with each method.

(2) The character of the crop. Small grains and forage crops which are best grown from broadcast sowing are open only to flooding

or sprinkling, and the latter is probably out of the question because of cost of outfit and attendance.

(3) The character of the soil. Soils naturally very open or loose, or market-garden soils rendered very loose by the constant and deep working in of coarse manures, favor such rapid percolation that even distribution through the soil mass can be had only by covering the surface rapidly with a uniform sheet of water. Under such conditions, also, flooding and sprinkling are the only practicable alternatives. The fact that sprinkling is not practiced to any extent in regions where much irrigation is done invites the conclusion that some form of flooding is better. On the other hand, for soils which take water slowly and distribute it well, both laterally and vertically, the furrow system, distributing water between long rows of plants, is best for plants which are profitably grown in rows, and on land of a grade which does not force too rapid flow of water.

(4) The labor requirement. The largest area can be evenly moistened with least labor by the contour check system and by the furrow system. Each is superior to all others in this respect for the conditions of land and crop to which it is adopted. The labor requirement in preparation of the ground has been so reduced by improved grading and leveling devices and by using permanent levees which allow all the ground to be cropped instead of counting the levees waste land, that the first cost of putting the land in shape for flooding in contour checks is but a slight addition to the grading necessary to remove the knolls and sags which is necessary in preparation for the furrow system.

(5) Ease of cultivation after irrigation. The desirability of stirring the soil surface after irrigation has already been mentioned in discussing methods of applying water. It is a means of checking evaporation and consequent lack of moisture, but it is more than that. The effect of irrigation is to draw the soil particles together, and if it be a soil containing much clay there is compacting followed by cracking as drying proceeds. In the old practice this condition was taken as a demand for more water, and another irrigation was given, which merely aggravated the trouble and plants came to distress. More water was used than necessary for good growth, and still thrift was not secured. The remedy is cultivation as soon after irrigation as the soil is in condition to break readily and become mellow and friable. Except, perhaps, where a mulch is used, cultivation is essential to the best soil condition, and consequently to the most satisfactory growth of the plant. It follows, then, that methods of irrigation which facilitate subsequent cultivation are to be preferred, wherever the ground slope and the character of the soil favor them. Of all methods that of irrigation by furrows between straight rows of considerable

length is obviously best for cultivation with horse tools, and is adopted by American growers wherever practicable. The foreign-born grower has a traditional preference for hand work, and is more apt to choose one of the flooding systems even where the furrow method would operate well. The furrow method can be used in a wide range of soils—in fact, as has been said, on all likely to be encountered except coarse, sandy loams, in which water sinks almost as fast as it is admitted to the furrow and makes very little lateral spread. In such soil a plant may suffer severely although it is very close to a furrow. For the distribution of the water evenly and to apply it to the upper soil where the shallow-rooting plant can use it, one of the flooding systems must be used, and cultivation must be well done at the earliest arrival of suitable soil condition. Although such a soil is not subject to baking and cracking it becomes "cemented" as the local term is, and then the effect of irrigation is of very short duration.

WHEN SHOULD WATER BE APPLIED?

This is a question to which a definite answer can not be given, except that water should not be applied before the plant shows distress. It therefore follows that the time when water should be applied can not be determined by watching the plant. Thrifty growth should characterize a crop from start to finish. Even a small degree of drought will induce some plants to enter upon maturing processes and then a new moisture supply may start an undesirable new growth rather than promote the old.

Many irrigators decide when their crops should be watered by an examination of the soil. A rule which has been frequently given is to take a handful of earth from a few inches below the surface and press it in the hand. If, when released, the soil holds together in a ball, and shows the marks of the fingers, irrigation is not necessary, but if it does not hold together water should be supplied. The time when crops should be irrigated, depends then, upon the nature of the crop, the soil, and the weather, so that no dates can be suggested for any locality.

The best sources of information on local practices are the agricultural experiment stations in the different States and Territories, which are now very properly giving much attention to this subject.

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45 to 57 bushels of wheat to the acre.

250 bushels of potatoes to the acre.

60 to 90 bushels of oats and barley to the acre.

These are exceptional yields of course, but not of single acres, but of whole fields in different portions of the South Platte Valley.

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Onions Weighing from 1 to 2½ pounds.

Beets Weighing from 3 to 26 pounds.

Cabbage Weighing from 20 to 30 pounds.

Potatoes Weighing from 1 to 3 pounds.